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ABSTRACT

This workbook, comprised of both the teacher and student editions, presents guidelines useful for first-year catfish farmers in Oklahoma using pond or cage cultures to raise channel catfish. The teacher edition is a set of unit guidelines only. Contents include a list of suggested readings, important addresses with types of information available from these sources, a listing of unit titles and unit sections in the student edition, a listing of unit worksheets in the student edition, and guidelines for each of the eight units: thinking about catfish culture; marketing; managing water supplies; planning production facilities; growing food fish; controlling catfish diseases and parasites; controlling predators, trash fish, and pests; and harvesting fish. The student edition begins with a list of suggested readings and important addresses, and presents the eight units. Each unit consists of: a list of unit objectives, content outlines, worksheets, and a unit review. (YLB)

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FIRST SEASON CATFISH FARMING

ED306389

Beginning Pond and Cage Culture of Channel Catfish

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TEACHER EDITION **STUDENT EDITION**

Oklahoma State Department of Vocational and Technical Education. Curriculum and Instructional Materials Center.

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First-Season Catfish Farming

A Workbook
for beginning pond and cage culture
of channel catfish

TEACHER EDITION

This Teacher Edition is not a complete Workbook
without the Student Edition.

developed by

Curriculum and Instructional Materials Center
Oklahoma State Department of Vocational and Technical Education
Roy Peters, Jr., Director
Oklahoma State Board of Vocational and Technical Education
Gerald Hoeltzel, Chairman

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FOREWORD

The Oklahoma State Department of Vocational and Technical Education is committed to economic development. Examples of this commitment can be seen in the many services vocational-technical education offers to Oklahoma's students, adults, and state businesses and industries.

One sector of the economy that has a great deal of economic development potential for the state is commercial catfish culture. The demand for high-quality, farm-raised catfish is growing. Catfish farmers in Oklahoma can meet this demand and contribute to economic development. Oklahoma has a variety of water resources and technical expertise to assist persons in developing catfish culture as a successful business.

This Workbook provides valuable guidelines for persons who are thinking about starting a catfish culture business.

The Oklahoma State Department of Vocational and Technical Education supports the commercial catfish producers and encourages their efforts.

Roy Peters, Jr.
State Director

TO THE TEACHER

1. Use this Teacher Edition with the Student Edition

   NOTE: This Teacher Edition is a set of unit guidelines only. This Teacher Edition is not a complete Workbook and must be used with the Student Edition.

2. Review the Disclaimer and the guidelines presented under the heading "To The Student"

3. Review each unit and plan your presentation

4. Supplement each unit with other resources

   a. Guest speakers -- State experts, county extension agents, successful catfish farmers, processors and other market representatives, etc.

   b. Written materials for reference, recommendation, or distribution-- Books, handbooks, pamphlets, bulletins, fact sheets, etc.

      NOTE: The "Suggested Reading" pages offer some examples of written materials.

5. Discuss the Unit Objectives before presenting each unit

6. Support each unit presentation with practical examples and experiences

7. Respond to the special situations of participants, or refer participants to qualified experts or to other sources of information

   NOTE: Having qualified experts on hand, including successful farmers, can be very helpful during your presentation of a particular unit.

8. Review each unit as needed, have participants complete each Unit Review, then discuss the answers

   NOTE: If participants have problems with any particular topic, review the appropriate sections in the unit as needed.

9. Arrange field-trips to catfish farms as often as is practical, to illustrate the information discussed in different units

   NOTE: You might decide to cover two or three units before arranging for a field-trip to illustrate the information in those units.

SUGGESTED READING

NOTE: Supplement the Workbook with these and other current sources.

General

1. Third Report to the Fish Farmers, edited by Harry K. Dupree and Jay V. Huner. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C., 1984.

   NOTE: Reprints of excerpts from the Third Report are available at low-cost from the Catfish Farmers of Oklahoma, P.O. Box 1650, McAlester, OK 74502. (918) 426-1879.

2. Small-Scale Caged Fish Culture in Oklahoma Farm Ponds (Fifth Edition), by Ken Williams, Donald P. Schwartz, and Glen E. Gebhart, Cooperative State Research Service, Langston University; and O. Eugene Maughan, Oklahoma Cooperative Fish and Wildlife Research Unit, Oklahoma State University. 1987. (Also includes a copy of the "Application for Aquatic Culture License.")

   Copies available from

   Glen E. Gebhart
   Langston University
   P.O. Box 730
   Langston, OK 73050

3. Catfish Farmer's Handbook, by Dr. Thomas L. Wellborn, Jr. Cooperative Extension Service, Mississippi State University, State College, Mississippi. (No date given).

   Copies available from

   Catfish Farmers of Oklahoma
   P.O. Box 1650
   McAlester, OK 74502
   (918) 426-1879

4. Guide for Prospective Catfish Farmers (Publication 1465), by Dr. Thomas L. Wellborn, Jr. Cooperative Extension Service, Mississippi State University, State College, Mississippi. (No date given).

5. Catfish Farming (Farmers' Bulletin Number 2260), prepared by the Soil Conservation Service, U.S. Department of Agriculture. 1981 (revised).

6. Pond Management In Oklahoma -- A Fish Pond Management Handbook, by the Fish Division, Oklahoma Department of Wildlife Conservation. 1981.

SUGGESTED READING

NOTE: Supplement the Workbook with these and other current sources.

7. Water Quality Management for Fish Farmers, by Conrad Kleinholz. From the series "Langston University Extension Facts."

   Copies available from

   Conrad Kleinholz
   Langston University
   P.O. Box 730
   Langston, OK 73050

8. Catfish Farming -- A Reference Unit, by Jasper S. Lee. Mississippi State University Curriculum Coordinating Unit for Vocational-Technical Education, in cooperation with Division of Vocational and Technical Education, Mississippi State Department of Education. 1971.

9. Conversions Useful in Fish Culture and Fishery Research and Management (Fish and Wildlife Leaflet 10), compiled by Brenda Rodgers Moore and Andrew J. Mitchell. United States Department of the Interior, Fish and Wildlife Service, Washington, DC. 1987.

   Copies available from

   Publications Unit
   U.S. Fish and Wildlife Service
   Matomic Bldg., Room 148
   Washington, DC 20240

   National Technical Information Service (NTIS)
   5285 Port Royal Road
   Springfield, VA 22161

Catfish Diseases and Parasites

1. Some Parasites and Diseases of Warmwater Fishes (Fish and Wildlife Leaflet 6), by Glenn L. Hoffman and Andrew J. Mitchell. Fish Farming Experimental Station, U.S. Fish and Wildlife Service, Stuttgart, Arkansas. 1986.

   Copies available from

   Publications Unit
   U.S. Fish and Wildlife Service
   Matomic Bldg., Room 148
   Washington, DC 20240

SUGGESTED READING

NOTE: Supplement the Workbook with these and other current sources.

2. Principal Diseases of Farm Raised Catfish, Southern Cooperative Series Bulletin No. 225. Revised October 1985.

   Copies available from

   Publications Office
   Department of Fisheries
   203 Swingle
   Auburn University
   Auburn, Alabama 36849
   (COST: $3.50)

3. Treatment Tips, by Fred P. Meyer. Fish Farming Experimental Station, U.S. Fish and Wildlife Service, Stuttgart, Arkansas. 1968.

   (How to determine the right amounts for chemical treatments.)

4. A Guide to Approved Chemicals in Fish Production and Fishery Resource Management, University of Arkansas Cooperative Extension Service and the U.S. Fish and Wildlife Service. (No date given).

   Copies available from

   University of Arkansas Cooperative Extension Service
   P.O. Box 391
   Little Rock, Arkansas 72203

5. Submitting Samples for Fish Disease Diagnosis, by Andrew J. Mitchell and Glenn L. Hoffman. Fish Farming Experimental Station, U.S. Fish and Wildlife Service, Stuttgart, Arkansas. 1985.

IMPORTANT ADDRESSES

NOTE: Use these contacts for more information about catfish culture.

Oklahoma Department of Wildlife Conservation
P.O. Box 53465
Oklahoma City, OK 73152
(405) 521-3851

* Application for the Aquatic Culture License
* Oklahoma Statutes relating to aquatic culture
* Information about controlling predators and pests, such as birds and burrowing animals, and permits if needed
* Directory of Aquaculture Permit Holders (Aquatic Licensees) in Oklahoma (by county)

Oklahoma Water Resources Board
1000 NE 10th -- P.O. Box 53585
Oklahoma City, OK 73152
(405) 271-2555

* Information about waste disposal (from processing your fish), as it relates to protecting water and groundwater supplies
* Questions about water rights -- stream water or groundwater
* Questions about discharging or returning water to its source (after being used in your catfish farming operation)
* OWRB Rules and Regulations
* Application for appropriate water resources permits

Soil Conservation Service
USDA Agricultural Center Building
Stillwater, OK 74074
(405) 624-4391

* Basic information about soils
* Assistance in designing ponds, surveying pond sites, setting pond stakes

County Extension Agents (for each county)

* Information about collecting soil (and water) samples for analysis
* "Fact Sheets"

Oklahoma Tax Commission
2501 Lincoln Boulevard
Oklahoma City, OK 73194-0018

* "Tax Guide for Commercial Fishermen," explaining how the federal tax laws apply to the fishing industry
* Questions about business taxes

IMPORTANT ADDRESSES

NOTE: Use these contacts for more information about catfish culture.

Catfish Farmers of Oklahoma (CFO)
P.O. Box 1650
McAlester, OK 74502
(918) 426-1879

* Information about the efforts of federal, state, and private agencies, universities, and private firms to help catfish farmers
* Access to information about catfish research and publications
* Advice from state experts
* Networking with other catfish farmers in the state
* Application for membership, CFO Bylaws, list of current officers and directors, "Oklahoma Aquaculture Newsletter"

STATE EXPERTS

Agricultural Research and Extension
Langston University
P.O. Box 730
Langston, OK 73050
(405) 466-3836

Aquaculture Specialist
OSU Extension
Ada, OK
(405) 332-4100

Agricultural Research Service
Tishomingo, OK

* Advice about all aspects of catfish farming
* Information about other sources to contact
* Annual Fish Culture Field Day at Langston University
* Questionnaire and computer program for estimating enterprise budgets--Contact Langston University for questionnaire; after you return the completed questionnaire, a budget printout will be sent to you

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A. Exploring Your Opportunities in Catfish Culture

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C. Identifying Risks and Legal Considerations

Unit Review

UNIT 2: Marketing

Unit Objectives

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B. Describing Common Operations and Market Needs

Unit Review

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B. Feeding Your Fish in Ponds and Cages

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D. Overwintering Your Fish

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UNIT 6: Controlling Catfish Diseases and Parasites

Unit Objectives

A. Recognizing Signs of Disease and Parasites

B. Following General Guidelines for Preventing, Diagnosing and Treating Diseases and Parasites

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UNIT 8: Harvesting Your Fish

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Recording Harvest Information

UNIT GUIDELINES

Unit 1
Thinking About Catfish Culture

A. Exploring Your Opportunities in Catfish Culture

1. Discuss Objective 1 -- Name reasons for farming catfish

   * Describe the current market for farm-raised catfish, and compare current demand with the expected demand.

   * Discuss the market share held by Mississippi processors, and its effects on catfish prices.

   * Give examples of suitable available water sources for catfish culture in Oklahoma.

   * Give examples of the income that potential farmers could expect to have, and the conditions that affect the income from catfish culture.

   * Compare catfish as a source of food to other sources, such as chicken, beef, pork, etc.

2. Discuss Objective 2 -- Describe methods of farming

   * Briefly describe each possible method of farming. (Unit 4, Section A compares production facilities.)

   * Explain that pond cultures account for most commercial catfish farms, while vat and raceway cultures are extremely risky and are still largely experimental in Oklahoma.

3. Discuss Objective 3 -- Identify types of market opportunities

   * Describe the volume of sales possible with each sales market.

   * Give examples of each type of market and ask participants for local examples.

   * Emphasize the NOTE and its implications for first-season farmers.

B. Reviewing Basic Time Requirements and Costs

4. Discuss Objective 4 -- State basic time requirements

   * Describe the time required for different tasks in catfish culture.

   * Emphasize the need for daily contact between farmers and their catfish, and give examples of possible problems caused by poor management of catfish, their environment, and records.

* Explain that this Workbook offers some guidelines to help participants achieve some of the elements of successful catfish cultures.

5. Discuss Objective 5 -- Explain the importance of time requirements

   * Explain why each numbered item is important.

6. Discuss Objective 6 -- List types of variable costs, fixed costs, and other costs

   * Give sample figures for each listed item.

   * Explain how farmers can reduce costs by using their own existing equipment.

   * Describe sample situations and the possible costs associated with each situation, such as sample cage cultures and their costs as compared to sample pond cultures and their costs.

C. Identifying Risks and Legal Considerations

7. Discuss Objective 7 -- Identify risks in catfish culture

   * Discuss each risk and its possible effects on the business of catfish culture, i.e., how can each risk threaten the success of the business?

   * Explain that these risks are just a part of the overall risk of starting any new business, and that success in catfish culture can depend on how well each farmer is prepared for these risks.

8. Discuss Objective 8 -- Identify basic guidelines for preparing for risks

   * Emphasize the importance of daily management for a successful catfish culture.

   * Discuss the consequences of failing to identify markets before starting a catfish farming operation.

   * Give examples of seasonal changes in the market demand for catfish.

   * Give examples of necessary records for catfish culture, and explain how each record is important to a successful business.

   * Use sample figures to calculate prices, and explain the importance of costs, profit, and prices to the success of a catfish culture.

UNIT GUIDELINES

9. Discuss Objective 9 -- Name legal considerations

   * Discuss each legal consideration and regulator.

   * Explain how catfish farmers work with these considerations every day.

10. Discuss Objective 10 -- Explore your ideas about catfish culture

   * Review the instructions to Worksheet 1-1.

UNIT GUIDELINES

Unit 2
Marketing

A. Identifying Markets for Your Fish

1. Discuss Objective 1 -- Define marketing in catfish culture

   * Define successful catfish farming as a business satisfying its markets and making a profit.

2. Discuss Objective 2 -- Describe the role of marketing in catfish culture

   * Describe the possible results when farmers plan an operation without first identifying markets for their product (farm-raised catfish).

3. Discuss Objective 3 -- Identify types of markets

   * Give examples of each type of market, especially <u>local</u> examples.

   * Describe the possible volume of sales to each type of market, expected repeat sales, and the management concerns for each possible sales volume.

4. Discuss Objective 4 -- Match the types of markets to their advantages and disadvantages

   * Explain the advantages and disadvantages of each type of market

5. Discuss Objective 5 -- Identify basic marketing questions

   * Explain how each of the "Basic Marketing Questions" is important to the success of a catfish farming operation.

   * Show how to calculate surface acreage and cubic feet of water available for catfish culture.

   * Include other important questions from your personal experience.

   * Invite local buyers of farm-raised catfish to answer questions about their markets.

   * Invite local catfish farmers to answer questions about identifying and finding potential markets.

6. Discuss Objective 6 -- Find possible markets

   * Review the instructions to Worksheet 2-1.

   * Discuss the possible advantages and disadvantages of sales to local markets or to more distant markets. What considerations are involved?

   * Complete sample entries as needed.

B. Describing Common Operations and Market Needs

7. Discuss Objective 7 -- Describe types of operations

   * Describe the different types of operations and the advantages and disadvantages of each type.

   * Discuss the management considerations for each type of operation.

8. Discuss Objective 8 -- Describe basic considerations for marketing, pricing, and selling

   * Explain that a key to business success is being able to give your markets the products they want. Knowing what your markets want involves considerations of product, price, place, and promotion.

   * Explain what could happen if a farmer does not address one or more of these considerations. For example, failure to consider the quality of the product could make customers stay away and lead to a bad reputation for the farm that could be very hard to overcome.

   * Ask for and show examples of ways to advertise your catfish. (Some are listed in Worksheet 2-2.)

   * Figure some examples of production costs and profit, to come up with a sample price. Then, compare the sample price with current prices (wholesale and retail). What should potential farmers do, if they determine that their estimated price and current prices do not compare?

   * Explain the ways of finding information about current prices, including any bulletins and where to get them. Distribute samples of price reports, if available.

   * Invite local buyers of farm-raised catfish to answer questions about how and when farmers should contact possible markets.

9. Discuss Objective 9 -- Outline your marketing plan

   * Review the instructions to Worksheet 2-2.

* Emphasize the importance of having a marketing plan for as many potential markets as possible. When completed, Worksheet 2-2 could provide important information for determining which markets will match the farmer's abilities and production possibilities.

* Complete sample entries in the "Marketing Plan" section as needed.

10. Discuss Objective 10 -- Match markets to operations

* Review the instructions to Worksheet 2-3.

* Describe a suitable commitment from a market.

* Complete sample entries as needed.

NOTE: The entries in Worksheet 2-3 should represent firm commitments from identified markets, if possible.

UNIT GUIDELINES

Unit 3
Managing Water Supplies

A. Identifying High-Quality Water Sources

1. Discuss Objective 1 -- Match the types of water sources to their advantages and disadvantages

   * Describe the advantages and disadvantages of each source of water, including any methods for solving a problem with a water source.

   * Ask participants to describe their water sources for catfish culture, and respond to each participant's special situation or refer the participant to a qualified guest speaker or to other sources of information.

2. Discuss Objective 2 -- List requirements of water sources

   * Explain why each requirement is important.

   * Solve some example problems for determining the volume of water in a pond in acre-feet. Use information about surface acreage and average depth from participants' ponds, if possible.

   * List some factors that influence the amount of water lost through evaporation or seepage during a typical growing season.

   * Distribute sample pages from soil survey books and explain how to determine the permeability of the soil.

3. Discuss Objective 3 -- Identify elements of water quality

   * Explain why each element is important.

   * Describe common ranges in dissolved oxygen levels, temperature, pH, and ammonia, and the possible responses to changes in each element.

   * Mention other elements of water quality that are not included in this unit, such as iron, nitrogen, carbon dioxide, hydrogen sulfide, hardness, etc.

   * Refer participants to qualified experts or to other sources of information about water quality.

4. Discuss Objective 4 -- List sources of information about water quality

   * Give examples of the information that can be gathered from a complete water analysis. Provide information about who to contact in your area.

* Provide names and addresses of test kit suppliers.

* Refer participants to the "Important Addresses" pages and to other reliable sources of information about water quality that you can recommend.

5. Discuss Objective 5 -- Identify your water source(s)

* Review the instructions to Worksheet 3-1.

* Explain the importance of collecting information about water sources before using the water.

* Explain each Worksheet question, if needed.

* Complete sample entries as needed.

6. Discuss Objective 6 -- Collect information about your water quality

* Review the instructions to Worksheet 3-2.

* Provide names and addresses of your county extension and/or soil conservation representatives.

* Explain the critical importance of high-quality water to a successful catfish farming business.

* Refer participants to the "Important Addresses" pages and to other reliable sources of information about water quality that you can recommend.

B. Controlling Dissolved Oxygen Levels

7. Discuss Objective 7 -- Define dissolved oxygen

* Explain the meaning of "parts per million" and "milligrams per liter."

8. Discuss Objective 8 -- Explain the importance of controlled dissolved oxygen levels

* Describe the daily cycle of the DO level and the reasons for the changes.

* Describe the effects of microscopic water plants and macrophytes on the DO level.

* Emphasize the need to monitor the DO level in every pond every day. This monitoring could include using test kits or oxygen meters, or could include noting signs of low dissolved oxygen.

9. Discuss Objective 9 -- Describe the daytime and nighttime levels of dissolved oxygen

   * Explain the process of photosynthesis and its affect on the DO level.

   * Review other causes and signs of low dissolved oxygen.

   * Discuss Figure 3-3.

10. Discuss Objective 10 -- Name some problems with low dissolved oxygen

   * Describe how each listed problem is a possible threat to your business.

   * Explain how dissolved oxygen is a factor in each listed problem.

11. Discuss Objective 11 -- Identify basic guidelines for measuring oxygen levels

   * Describe how to visually check for signs of low DO levels every day, and the participant's response to a possible low DO level.

   * Discuss the advantages and disadvantages of different ways to measure DO levels.

   * Show how to read an oxygen meter and a test kit reading.

   * Emphasize how quickly DO levels can change, and the need to be ready to correct any problems with low DO levels at any time. A whole pond or cage culture could be lost.

12. Discuss Objective 12 -- Identify basic guidelines for preventing low dissolved oxygen

   * Give examples of pumping systems/methods for circulating water.

   * Demonstrate how to check the density of phytoplankton using a Secchi disk or your arm.

   * Describe ways to control phytoplankton bloom.

   * Explain how feeding activity can indicate a low DO level.

   * Describe simple, hand-made aeration equipment and/or distribute sample catalogs and addresses of equipment suppliers.

     NOTE: Suppliers may provide you with enough catalogs for your participants.

* Emphasize the risk of a DO "sag." (See the CAUTION.)

* Review "safe" temperature ranges.

* Describe how manure, feeds, and plant materials can lower the DO level. Also warn of the dangers of fertilizing the water.

13. Discuss Objective 13 -- Check for signs of low dissolved oxygen

* Review the instructions to Worksheet 3-3.

14. Discuss Objective 14 -- Predict nighttime dissolved oxygen levels in ponds

* Review the instructions to Worksheet 3-4.

* Solve some example problems, in addition to the Worksheet problems.

* Answer the Worksheet problems after all participants have had time to work on the problem.

* Explain the responses needed in case of a predicted low nighttime DO level.

C. Preparing for Stratification and Destratification

15. Discuss Objective 15 -- Define stratification, destratification, and biological oxygen demand

* Illustrate each definition with a diagram, if possible.

* Emphasize the CAUTION.

16. Discuss Objective 16 -- Identify sources of high BOD

* Explain how each numbered item contributes to high BOD.

17. Discuss Objective 17 -- Identify periods of overturn

* Give examples of common periods of overturn, and ways to predict overturn.

* Explain how farmers should react to overturn, including overturn accompanied by high BOD.

D. Controlling Off-Flavor Problems

18. Discuss Objective 18 -- Define off-flavor

    * Give examples of sources of off-flavor in catfish.

    * Compare a catfish to a sponge, absorbing the characteristics of the water. Polluted water can lead to polluted catfish.

19. Discuss Objective 19 -- Identify off-flavor expenses

    * Explain off-flavor expenses from loss of sales as unnecessary expenses that could be saved through good management practices and preventive steps. An off-flavor problem should be identified in time to correct the problem before selling the fish.

    * Emphasize the fact that off-flavor will happen to all farmers, and can happen during transport even though the catfish were not off-flavor at harvest.

20. Discuss Objective 20 -- List signs of off-flavor

    * Describe the different off-flavors.

    * Explain how to identify an off-flavor problem.

21. Discuss Objective 21 -- Identify basic guidelines for preventing off-flavor

    * Refer back to the elements of water quality, and the importance of daily management of water supplies and awareness of potential problems.

    * Explain how polluted water, blue-green algae, and stale feeds can cause off-flavor in catfish.

    * Describe ways of recognizing stale feeds.

    * Explain how overstocking can lead to off-flavor.

E. Controlling Weeds

22. Discuss Objective 22 -- Name problems with weeds

    * Give examples of each problem.

23. Discuss Objective 23 -- Distinguish among types of weeds

    * Describe common problems with each type of weed.

* Describe how to identify phytoplankton bloom while checking your ponds or cages every day, and show how to use a Secchi disk or your arm to measure phytoplankton density.

24. Discuss Objective 24 -- Match the methods of weed control to their advantages and disadvantages

* Give examples of each advantage and disadvantage, if possible.

25. Discuss Objective 25 -- Identify basic guidelines for controlling weeds

* Explain how to recognize weed problems through daily observation.

* Explain ways of identifying plant species, or refer participants to qualified experts for help.

* Describe common situations, and ask participants to identify a suitable control method for each situation.

* Refer participants to the "Important Addresses" pages and to other reliable sources of information about weed control methods that you can recommend, especially regarding chemical control.

* Explain how to choose and apply the right chemical, if a chemical control is necessary. Show how to compute the application rate for the chemical.

* Distribute lists of approved chemicals.

UNIT GUIDELINES

Unit 4
Planning Production Facilities

A. Comparing Production Facilities

1. Discuss Objective 1 -- Match the types of catfish culture to their advantages and disadvantages

   * Give examples of each advantage and disadvantage. For example, a pond culture can offer a higher volume of production. Compare the production levels of a sample pond culture with a sample cage culture, etc.

   * Describe land site conditions, financial conditions, and other factors that participants should consider when comparing production facilities and choosing pond or cage culture.

B. Planning for Pond Culture

2. Discuss Objective 2 -- List the basics of pond cultures

   * Explain why each item is important to pond culture.

3. Discuss Objective 3 -- Distinguish between types of ponds

   * Draw a simple watershed and levee pond, to help explain the differences between the two types.

   * Discuss the advantages and disadvantages of watershed and levee ponds.

   * Discuss the advantages and disadvantages of large ponds and small ponds.

4. Discuss Objective 4 -- Describe features of suitable land sites

   * Describe the features of a high-quality soil for catfish culture.

   * Ask participants to describe their ponds or land sites, then discuss the suitability of their sites for pond culture. Can they adapt the existing site? Should they consider building a pond for fish culture?

   * Compare the expenses of using a suitable existing site and building a new site.

5. Discuss Objective 5 -- Identify factors of pond design

   * Draw a simple diagram of a levee having a suitable slope.

* Explain the importance of the ground features (pond bottom).

* Explain the difference in the depth needed for pond culture, as compared to cage culture.

* Draw a simple layout of a drainage system for pond culture, and suggest materials needed to adapt or build a system.

* Describe the access needed for different tasks and situations.

* Explain the importance of considering the method of harvesting when designing a pond.

* Describe a simple water supply system and explain the regulations and permit requirements. Refer participants to other sources of information about regulations and permits.

* Describe dangerous situations around pond cultures and ways to prevent those situations.

6. Discuss Objective 6 -- List types of drainage systems

* Detail the advantages and disadvantages of each type of drainage system.

* Describe situations requiring or suggesting the use of each system.

7. Discuss Objective 7 -- List basic drainage requirements

* Explain the importance of each requirement and give examples of each.

* Describe a good drainage system and the costs of adapting or building the system.

8. Discuss Objective 8 -- Review land sites for pond culture

* Review the instructions to Worksheet 4-1.

* Invite a soil conservation representative to answer questions about land sites and the services offered by the Soil Conservation Service.

* Read through each question with your class, to make sure that all questions are clear. (Participants must complete this Worksheet on their own outside the class.)

* Discuss the Worksheets at a later class session, when all participants have had time to complete the Worksheet.

9. Discuss Objective 9 -- Estimate the costs of building pond cultures

   * Review the instructions to Worksheet 4-2.

   * Invite catfish farmers, heavy equipment operators, and others to answer questions about building a pond culture.

   * Make and distribute a list of local sources for estimates.

   * Discuss the importance of the General Pre-Construction Questions.

   * Complete a sample cost estimate, to show typical requirements and their costs. (Outline common elements in a cost estimate.)

10. Discuss Objective 10 -- Record surface area and volume

   * Review the instructions to Worksheet 4-3.

   * Explain the use of area and volume measurements in calculating disease treatments.

   * Emphasize the benefits of finding and recording these measurements before filling a pond, and show how to mark the water stages.

C. Planning for Cage Culture

11. Discuss Objective 11 -- List pond requirements for cage culture

   * Explain the importance of deep water for a successful cage culture (6-10 feet deep).

12. Discuss Objective 12 -- Identify cage requirements

   * Explain the importance of each requirement.

   * Draw a simple cage that shows each requirement, or show photographs of cages meeting each requirement.

13. Discuss Objective 13 -- List cage cost factors

   * Compare the cost of a home-built cage and a cage from an equipment supplier.

   * Discuss the advantages and disadvantages of box-shape and cylinder-shape cages.

   * Distribute samples of cage mesh material and make a list of common materials needed to build cages.

   * Distribute a list of equipment suppliers.

14. Discuss Objective 14 -- Identify basic guidelines for the placement of cages

    * Explain the importance of each guideline.

    * Draw a simple diagram of a cage culture.

15. Discuss Objective 15 -- Describe feeds for cage culture

    * Compare feeds suitable for pond culture and feeds suitable for cage culture.

    * Explain what to look for when buying feed for cage culture. (Worksheet 5-1 goes into more detail about identifying feeds.)

    * Recommend suitable feeds for cage culture.

16. Discuss Objective 16 -- Identify basic guidelines for stocking cage cultures

    * Explain the importance of each guideline.

    * Emphasize the importance of starting out on a small scale, and describe some benefits of experience.

UNIT GUIDELINES

Unit 5
Growing Food Fish

A. Stocking Your Fish in Ponds and Cages

1. Discuss Objective 1 -- Match stocking sizes of fingerlings to their possible harvest sizes in one season

   * Give examples of different markets or needs requiring each stocking size to reach each harvest size.

     EXAMPLE: Which markets require a 2-3 pound catfish at harvest (therefore needing an 8"-10" fingerling)?

   * Give examples of growing conditions that could affect the size of fingerlings at harvest.

2. Discuss Objective 2 -- Describe stocking rates in ponds and cages

   * Explain how to judge or estimate the carrying capacity of a pond.

   * Discuss the advantages of starting out on a small scale, and the risks of stocking too many fish during the first season as a catfish farmer.

   * Explain how stocking rates affect the growth of catfish.

3. Discuss Objective 3 -- Describe stocking periods

   * Explain why cage cultures need warmer water for stocking.

   * Describe the possible results of stocking early or late.

4. Discuss Objective 4 -- List signs of high-quality fingerlings

   * Discuss the importance of each numbered sign, and the possible consequences of using fingerlings that do not meet these standards.

   * Emphasize the need to get the fingerlings you want, not just the fingerlings that a supplier has available.

   * Recommend suppliers of fingerlings.

5. Discuss Objective 5 -- Discuss growth factors

   * Describe how each factor can affect the growth of catfish. (Refer to Unit 3 if needed.)

6. Discuss Objective 6 -- Identify guidelines for stocking

   * Discuss the importance of each guideline.

   * Refer back to suggested stocking rates when discussing overcrowding.

   * Give examples of the risks or losses involved when transporting fingerlings (emphasizing the need to avoid transporting fingerlings yourself).

   * Explain the importance of getting fingerlings on feed when stocking, and suggest ways to do it.

B. Feeding Your Fish in Ponds and Cages

7. Discuss Objective 7 -- List basic feed requirements

   * Discuss the importance of each requirement.

   * Show examples of different feeds (handfuls).

   * Show examples of feed labels and discuss the label information. (See Worksheet 5-1.)

8. Discuss Objective 8 -- Identify amounts to feed

   * Review the effects of water temperature on feeding rates.

   * Give examples of the possible effects of excess feed on water quality.

   * Give some guidelines for adjusting feed amounts -- under what circumstances should feed amounts be adjusted?

9. Discuss Objective 9 -- Define feed conversion efficiency (FCE)

   * Calculate sample FCE's using figures that you provide, and explain what the FCE indicates to a farmer.

10. Discuss Objective 10 -- List the uses of FCE

    * Respond to your sample FCE's from Objective 9 -- use those FCE's in the three ways listed.

11. Discuss Objective 11 -- Identify factors influencing FCE's

    * Explain how each factor can influence the FCE.

12. Discuss Objective 12 -- Identify causes of changes in feeding activity

* Review the temperature range for feeding.

* Describe a safe range for dissolved oxygen during feeding.

* Give examples of catfish diseases and their effects on feeding activity.

* Describe situations involving excessive handling of catfish.

* Emphasize the importance of stocking ponds and cages on a small scale for first-season farmers.

* Give examples of feeding routines and feeding times, and emphasize the need to follow a routine.

13. Discuss Objective 13 -- Describe methods of feeding

* Emphasize the importance of personal daily contact with your catfish, especially for first-season farmers.

* Describe a simple demand feeder.

* Invite a successful catfish farmer to discuss methods of feeding.

14. Discuss Objective 14 -- Identify basic guidelines for feeding

* Describe a high-quality feed. (See Worksheet 5-1.)

* Show examples of feed labels.

* Explain the importance of feeding at about the same time every day-- why is a routine important?

* Give some general guidelines for adjusting the amount of feed used.

* Emphasize the importance of accurate records and give examples of how farmers can use their feed records.

15. Discuss Objective 15 -- Identify possible feeds for catfish culture

* Review the instructions to Worksheet 5-1.

* Discuss the ingredients on the "Comparison Chart."

* Complete the Worksheet using a sample feed label from a local feed supplier.

16. Discuss Objective 16 -- Record feed totals

    * Review the instructions to Worksheet 5-2.

    * Explain how a Feeding Record (any version) is an important document for successful catfish operations.

    * Complete sample entries as needed. (Weekly totals can be used to calculate monthly totals.)

C. Handling Your Fish

17. Discuss Objective 17 -- Identify basic guidelines for handling

    * Explain the importance of each guideline.

    * Calculate sample salt solutions for different volumes of water, and explain how to use salt while handling and stocking.

    * Invite an expert to discuss the use of prophylactic treatments.

D. Overwintering Your Fish

18. Discuss Objective 18 -- Define overwintering

    * Give examples of situations where overwintering may be required.

    * Describe the risks that are "extended" by overwintering.

19. Discuss Objective 19 -- State reasons for winter feeding

    * Give examples of catfish weights required by a market, and the need to overwinter those fish to reach the required size.

    * Describe the changes in feeding activity and growth that occur during the winter.

20. Discuss Objective 20 -- Identify guidelines for winter feeding

    * Invite experts or successful catfish farmers to answer questions about overwintering and winter feeding.

    * Compare a summer feeding schedule with a winter feeding schedule.

UNIT GUIDELINES

Unit 6
Controlling Catfish Diseases and Parasites

A. Recognizing Signs of Disease and Parasites

1. Discuss Objective 1 -- Name disease and parasite expenses

   * Explain how the interruption of normal production activities, caused by a disease or parasite problem, is a business expense.

   * Give examples of the possible size of each expense. For example, how many fish might be lost? How much could it cost to treat the fish?

   * Describe the responses of catfish to common treatments for specific disease and parasite problems.

2. Discuss Objective 2 -- Identify behavioral signs of disease and parasites

   * Describe ways of spotting the behavioral signs during a daily routine.

   * Give examples of possible responses if a farmer believes that a disease or parasite problem exists.

3. Discuss Objective 3 -- Identify physical signs of disease and parasites

   * Describe ways of spotting the physical signs during a daily routine.

   * Show examples of catfish having the physical signs of disease or parasites, if possible, using samples kept on ice or by showing photographs.

   * Give examples of possible responses if a farmer believes that a disease or parasite problem exists.

4. Discuss Objective 4 -- Check for signs of disease and parasites

   * Review the instructions ("NOTE") to Worksheet 6-1.

   * Complete sample entries as needed.

B. Following General Guidelines for Preventing, Diagnosing and Treating Diseases and Parasites

5. Discuss Objective 5 -- Identify basic guidelines for preventing diseases and parasites

   * Refer to the elements of water quality and the need to manage water supplies.

* Describe a high-quality fingerling and explain the possible results from buying poor-quality fingerlings.

* Discuss common causes of stress in catfish and explain how to reduce stress levels.

* List the components of a typical high-quality feed. (Refer to Worksheet 5-1.)

6. Discuss Objective 6 -- Identify basic guidelines for diagnosing diseases and parasites

* Emphasize the importance of preventing disease or parasite problems, and describe the expenses that could result from poor preventive measures.

* Give examples of some common "warning signs" of a disease or parasite problem.

* Identify state experts who can advise farmers.

* Describe example situations where poor water quality, poor feed quality, or poor management practices could promote a disease or parasite problem.

* Explain the limits of expert advice from state experts, other farmers, or written materials. Farmers can still lose fish even after correctly and quickly responding to the signs of a disease or parasite problem. Also, expert advice may not solve your problem.

7. Discuss Objective 7 -- Identify basic guidelines for treating diseases and parasites

* Provide names and addresses of experts to contact.

* Describe a common situation and compare the possible solutions. Discuss the implications or consequences of each question listed for comparing possible solutions.

* Discuss approved chemical treatments and when to use them. Distribute lists of approved chemicals.

* Use sample labels and go step-by-step through the correct procedure for using the chemical.

8. Discuss Objective 8 -- List sources of information about preventing, diagnosing, and treating diseases and parasites

* Review the "Suggested Reading" pages

* Provide names and addresses for qualified advice

* Refer participants to the "Important Addresses" pages and to other reliable sources of information about preventing, diagnosing, and treating diseases and parasites (sources that you can recommend).

9. Discuss Objective 9 -- Record signs of disease and parasites

* Review the instructions to Worksheet 6-2.

* Explain the limits of expert advice. (See the Suggested Activities under Objective 6.)

UNIT GUIDELINES

Unit 7
Controlling Predators, Trash Fish, and Pests

A. Controlling Predators

1. Discuss Objective 1 -- Define a predator

   * Give examples of the possible losses from different types of predators.

2. Discuss Objective 2 -- Match types of predators with the problems each type can cause

3. Discuss Objective 3 -- Match types of predators with possible methods for controlling each type

   * Invite an expert to explain the laws that may protect some types of predators, and the procedures needed to get permission to control those predators. (Other catfish farmers could also describe their experiences.)

   * Describe a simple turtle trap.

   * Explain where to find bullfrog eggs and how to recognize them.

   * Briefly refer to filter controls.

   * Refer to sources of information about using copper sulfate, lime, or ammonium phosphate. (Refer to books and pamphlets available and/or discuss sample chemical packages and their instructions.)

B. Controlling Trash Fish

4. Discuss Objective 4 -- Define a trash fish

   * Explain how trash fish can get into a catfish culture.

5. Discuss Objective 5 -- Name problems with trash fish

   * Give examples of each problem.

6. Discuss Objective 6 -- Identify box, saran sock, and inlet filter controls

   * Explain the advantages and disadvantages of each filter control.

   * Show samples of filter materials (screens).

   * Describe ways to make simple filters.

7. Discuss Objective 7 -- List management controls

   * Describe the advantages of well water.

   * Describe the way that a turndown pipe works.

   * Explain how to build a simple turndown pipe.

   * Discuss other management controls from your own experience.

C. Controlling Pests

8. Discuss Objective 8 -- Define a pest

9. Discuss Objective 9 -- Describe types of pests and the problems each type can cause

   * Give examples of situations where each problem can happen.

10. Discuss Objective 10 -- Match types of pests with possible methods for controlling each type

11. Discuss Objective 11 -- List sources of information about controlling predators, trash fish, and pests

   * Provide names and addresses.

   * Refer participants to the "Important Addresses" pages and to other reliable sources of information about controlling predators, trash fish, and pests (sources that you can recommend).

UNIT GUIDELINES

Unit 8
Harvesting Your Fish

A. Reviewing General Guidelines for Harvesting

1. Discuss Objective 1 -- Describe types of harvests

   * Discuss the advantages and disadvantages of each type of harvest.

   * Explain the considerations that influence which type of harvest a farmer should choose.

2. Discuss Objective 2 -- Explain when to harvest

   * Give examples of each consideration.

   * Describe "typical" prices at the end of the growing season, and explain why prices are lowest at that time.

3. Discuss Objective 3 -- Describe methods of harvesting

   * State that harvesting methods should be considered when designing and planning a pond.

4. Discuss Objective 4 -- Identify basic guidelines for planning your harvest

   * Explain the importance of each guideline.

   * Invite processors to answer questions about their harvesting services and the advance preparation required from farmers.

   * Emphasize the importance of correcting off-flavor problems before harvesting. (Refer participants to Unit 3 for the signs of off-flavor.)

B. Harvesting Cages

5. Discuss Objective 5 -- List basic equipment for harvesting cages

   * Show examples of the equipment, if possible.

   * Estimate the cost of each item and explain opportunities for using existing equipment.

6. Discuss Objective 6 -- List in order the basic steps for harvesting cages

   * Describe a good and safe way of performing each step, and add other steps if needed.

* Refer to the Figures listed.

* Identify any problems that could occur with each step and suggest ways to prevent or correct each problem.

C. Harvesting Ponds

7. Discuss Objective 7 -- List basic equipment for harvesting ponds

* Show examples (including photographs) of the equipment, if possible.

* Estimate the cost of each item and explain opportunities for using existing equipment.

8. Discuss Objective 8 -- List in order the basic steps for seining

* Describe a good and safe way of performing each step, and add other steps if needed.

* Refer to the Figures listed.

* Identify any problems that could occur with each step and suggest ways to prevent or correct each problem.

9. Discuss Objective 9 -- List in order the basic steps for trap-seining

* Explain the importance of preparing the seine before the harvest.

* Explain how noise could affect the results of the harvest.

* Describe a good and safe way of performing each step, and add other steps if needed.

* Refer to the Figures listed.

* Identify any problems that could occur with each step and suggest ways to prevent or correct each problem.

D. Holding and Transporting Your Fish

10. Discuss Objective 10 -- State options in holding and transporting

* Explain how a farmer would choose an option (or how the farmer's markets determine the option).

* Discuss the advantages and disadvantages of each option.

UNIT GUIDELINES

11. Discuss Objective 11 -- Identify requirements for holding

    * Explain the importance of each requirement.

    * State that a holding tank may not be needed if fish are harvested directly into a transport tank (as shown in Figure 8-12).

    * Show photographs of holding tanks, transport tanks, and aeration equipment. (You could show photographs of your own equipment.)

12. Discuss Objective 12 -- Identify requirements for transporting

    * Explain the importance of each requirement.

    * Explain how to use dechlorinator and anti-foaming surfactant.

13. Discuss Objective 13 -- Identify basic guidelines for transporting

    * Explain the importance of each guideline.

    * Give examples of water volume in transport tanks and the quantity of ice that could be used to lower the temperature of each volume of water.

    * Describe the effects of temperature extremes.

    * Calculate sample salt solutions for different volumes of water.

14. Discuss Objective 14 -- Record harvest information

    * Review the instructions to Worksheet 8-1.

    * Discuss the importance of keeping accurate harvest records.

    * Explain the Worksheet as <u>one</u> possible harvest record. Participants can adapt this Worksheet or create their own harvest records.

First-Season Catfish Farming

A Workbook
for beginning pond and cage culture
of channel catfish

STUDENT EDITION

developed by

Curriculum and Instructional Materials Center
Oklahoma State Department of Vocational and Technical Education
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DISCLAIMER

Purpose of this Workbook

This Workbook presents some guidelines useful for first-year catfish farmers in Oklahoma using pond or cage cultures to raise channel catfish. This Workbook is not a complete source of information about catfish culture. You must supplement the information in this Workbook with other available sources. This Workbook does not cover advanced operations such as vats and raceways.

Conditions for successful catfish culture may vary. If this Workbook is being used outside of the state of Oklahoma, consult the appropriate experts about the conditions that may vary from one region or state to another.

Risks in Catfish Culture

Catfish culture involves risks for beginners and experienced farmers. This Workbook cannot guarantee lower risks in catfish culture. Success in catfish farming depends on many factors that are different from one operation to another. These factors include soil and water quality, fingerling quality, extent of predation, habits of fish from one pond or cage to another, your management techniques, and others. The guidelines in this Workbook may work for some farmers, but not for others.

The materials and information in this Workbook have been gathered from sources believed to be reliable and to represent current opinion on the subject of catfish culture in Oklahoma. No warranty, or guarantee, is made by the Oklahoma State Department of Vocational and Technical Education or other contributors as to the absolute correctness or sufficiency of any material contained in this Workbook. The Oklahoma State Department of Vocational and Technical Education and contributors assume no responsibility in connection herewith.

FOREWORD

The Oklahoma State Department of Vocational and Technical Education is committed to economic development. Examples of this commitment can be seen in the many services vocational-technical education offers to Oklahoma's students, adults, and state businesses and industries.

One sector of the economy that has a great deal of economic development potential for the state is commercial catfish culture. The demand for high-quality, farm-raised catfish is growing. Catfish farmers in Oklahoma can meet this demand and contribute to economic development. Oklahoma has a variety of water resources and technical expertise to assist persons in developing catfish culture as a successful business.

This Workbook provides valuable guidelines for persons who are thinking about starting a catfish culture business.

The Oklahoma State Department of Vocational and Technical Education supports the commercial catfish producers and encourages their efforts.

Roy Peters, Jr.
State Director

ACKNOWLEDGMENTS

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TO THE STUDENT

1. Read this Workbook for basic information about pond or cage culture of channel catfish

   NOTE: This .Workbook emphasizes first-season considerations in catfish culture and is based on conditions and experiences in Oklahoma. These conditions and experiences may not apply for all readers and situations. Consult the appropriate experts about the conditions that may vary from one region or state to another.

2. Support each unit in this Workbook with other sources of information

   NOTE: See the "Suggested Reading" and the "Important Addresses" pages in this Workbook.

3. Follow any guidelines or techniques that work for your catfish culture, and avoid any that do not work for your operation

   NOTE: Learn from your experiences and those of successful catfish farmers.

4. Use the Worksheets to help you apply the information presented in the unit, or to help you evaluate a situation or condition

   NOTE: Some of the Worksheets are "exercises" that can help you to apply the information you have learned, while other Worksheets are examples of possible records that you can use or adapt for your own catfish culture.

5. Complete each Unit Review to test your understanding of the information in each unit

   NOTE: Your performance on each Unit Review does not guarantee your success or failure in catfish culture.

SUGGESTED READING

NOTE: Supplement this Workbook with these and other current sources.

General

1. Third Report to the Fish Farmers, edited by Harry K. Dupree and Jay V. Huner. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C., 1984.

   NOTE: Reprints of excerpts from the Third Report are available at low-cost from the Catfish Farmers of Oklahoma, P.O. Box 1650, McAlester, OK 74502. (918) 426-1879.

2. Small-Scale Caged Fish Culture in Oklahoma Farm Ponds (Fifth Edition), by Ken Williams, Donald P. Schwartz, and Glen E. Gebhart, Cooperative State Research Service, Langston University; and O. Eugene Maughan, Oklahoma Cooperative Fish and Wildlife Research Unit, Oklahoma State University. 1987. (Also includes a copy of the "Application for Aquatic Culture License.")

   Copies available from

   Glen E. Gebhart
   Langston University
   P.O. Box 730
   Langston, OK 73050

3. Catfish Farmer's Handbook, by Dr. Thomas L. Wellborn, Jr. Cooperative Extension Service, Mississippi State University, State College, Mississippi. (No date given).

   Copies available from

   Catfish Farmers of Oklahoma
   P.O. Box 1650
   McAlester, OK 74502
   (918) 426-1879

4. Guide for Prospective Catfish Farmers (Publication 1465), by Dr. Thomas L. Wellborn, Jr. Cooperative Extension Service, Mississippi State University, State College, Mississippi. (No date given).

5. Catfish Farming (Farmers' Bulletin Number 2260), prepared by the Soil Conservation Service, U.S. Department of Agriculture. 1981 (revised).

6. Pond Management In Oklahoma -- A Fish Pond Management Handbook, by the Fish Division, Oklahoma Department of Wildlife Conservation. 1981.

SUGGESTED READING

NOTE: Supplement this Workbook with these and other current sources.

7. Water Quality Management for Fish Farmers, by Conrad Kleinholz. From the series "Langston University Extension Facts."

   Copies available from

   Conrad Kleinholz
   Langston University
   P.O. Box 730
   Langston, OK 73050

8. Catfish Farming -- A Reference Unit, by Jasper S. Lee. Mississippi State University Curriculum Coordinating Unit for Vocational-Technical Education, in cooperation with Division of Vocational and Technical Education, Mississippi State Department of Education. 1971.

9. Conversions Useful in Fish Culture and Fishery Research and Management (Fish and Wildlife Leaflet 10), compiled by Brenda Rodgers Moore and Andrew J. Mitchell. United States Department of the Interior, Fish and Wildlife Service, Washington, DC. 1987.

   Copies available from

   Publications Unit
   U.S. Fish and Wildlife Service
   Matomic Bldg., Room 148
   Washington, DC 20240

   National Technical Information Service (NTIS)
   5285 Port Royal Road
   Springfield, VA 22161

Catfish Diseases and Parasites

1. Some Parasites and Diseases of Warmwater Fishes (Fish and Wildlife Leaflet 6), by Glenn L. Hoffman and Andrew J. Mitchell. Fish Farming Experimental Station, U.S. Fish and Wildlife Service, Stuttgart, Arkansas. 1986.

   Copies available from

   Publications Unit
   U.S. Fish and Wildlife Service
   Matomic Bldg., Room 148
   Washington, DC 20240

SUGGESTED READING

NOTE: Supplement this Workbook with these and other current sources.

2. Principal Diseases of Farm Raised Catfish, Southern Cooperative Series Bulletin No. 225. Revised October 1985.

   Copies available from

   Publications Office
   Department of Fisheries
   203 Swingle
   Auburn University
   Auburn, Alabama 36849
   (COST: $3.50)

3. Treatment Tips, by Fred P. Meyer. Fish Farming Experimental Station, U.S. Fish and Wildlife Service, Stuttgart, Arkansas. 1968.

   (How to determine the right amounts for chemical treatments.)

4. A Guide to Approved Chemicals in Fish Production and Fishery Resource Management, University of Arkansas Cooperative Extension Service and the U.S. Fish and Wildlife Service. (No date given).

   Copies available from

   University of Arkansas Cooperative Extension Service
   P.O. Box 391
   Little Rock, Arkansas 72203

5. Submitting Samples for Fish Disease Diagnosis, by Andrew J. Mitchell and Glenn L. Hoffman. Fish Farming Experimental Station, U.S. Fish and Wildlife Service, Stuttgart, Arkansas. 1985.

IMPORTANT ADDRESSES

NOTE: Use these contacts for more information about catfish culture.

Oklahoma Department of Wildlife Conservation
P.O. Box 53465
Oklahoma City, OK 73152
(405) 521-3851

* Application for the Aquatic Culture License
* Oklahoma Statutes relating to aquatic culture
* Information about controlling predators and pests, such as birds and burrowing animals, and permits if needed
* Directory of Aquaculture Permit Holders (Aquatic Licensees) in Oklahoma (by county)

Oklahoma Water Resources Board
1000 NE 10th -- P.O. Box 53585
Oklahoma City, OK 73152
(405) 271-2555

* Information about waste disposal (from processing your fish), as it relates to protecting water and groundwater supplies
* Questions about water rights -- stream water or groundwater
* Questions about discharging or returning water to its source (after being used in your catfish farming operation)
* OWRB Rules and Regulations
* Application for appropriate water resources permits

Soil Conservation Service
USDA Agricultural Center Building
Stillwater, OK 74074
(405) 624-4391

* Basic information about soils
* Assistance in designing ponds, surveying pond sites, setting pond stakes

County Extension Agents (for each county)

* Information about collecting soil (and water) samples for analysis
* "Fact Sheets"

Oklahoma Tax Commission
2501 Lincoln Boulevard
Oklahoma City, OK 73194-0018

* "Tax Guide for Commercial Fishermen," explaining how the federal tax laws apply to the fishing industry
* Questions about business taxes

IMPORTANT ADDRESSES

NOTE: Use these contacts for more information about catfish culture.

Catfish Farmers of Oklahoma (CFO)
P.O. Box 1650
McAlester, OK 74502
(918) 426-1879

* Information about the efforts of federal, state, and private agencies, universities, and private firms to help catfish farmers
* Access to information about catfish research and publications
* Advice from state experts
* Networking with other catfish farmers in the state
* Application for membership, CFO Bylaws, list of current officers and directors, "Oklahoma Aquaculture Newsletter"

STATE EXPERTS

Agricultural Research and Extension
Langston University
P.O. Box 730
Langston, OK 73050
(405) 466-3836

Aquaculture Specialist
OSU Extension
Ada, OK
(405) 332-4100

Agricultural Research Service
Tishomingo, OK

* Advice about all aspects of catfish farming
* Information about other sources to contact
* Annual Fish Culture Field Day at Langston University
* Questionnaire and computer program for estimating enterprise budgets--Contact Langston University for questionnaire; after you return the completed questionnaire, a budget printout will be sent to you

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CORRECTIONS AND SUGGESTIONS

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Stillwater, Oklahoma 74074-4364

1. Thinking About Catfish Culture

Unit Objectives

After completing this unit, you should be able to

1. Name reasons for farming catfish
2. Describe methods of farming
3. Identify types of market opportunities
4. State basic time requirements
5. Explain the importance of time requirements
6. List types of variable costs, fixed costs, and other costs
7. Identify risks in catfish culture
8. Identify basic guidelines for preparing for risks
9. Name legal considerations
10. Explore your ideas about catfish culture (WORKSHEET 1-1)

1. Thinking About Catfish Culture

A. Exploring Your Opportunities in Catfish Culture

Reasons for Farming Catfish

1. Growth of the Market -- The demand for quality farm-raised catfish is high

2. Availability of Water -- Oklahoma has a variety of water sources that can be used to raise catfish

3. Source of Income -- Catfish farming can be a source of extra income or your main cash crop

   NOTE: The size of your catfish farming operation depends on the number of fish you want to farm, your time and financial resources, the markets available for your fish, and other factors.

4. Source of Food -- Catfish farming provides you with a supply of low cost, high quality food for you, your family, and for others

Methods of Farming

1. Pond culture -- Uses natural or man-made ponds that are seinable and drainable

   NOTE: You can build ponds, or use farm ponds or other natural ponds to raise your fish. However, both natural and man-made ponds must meet certain standards as production facilities.

2. Cage culture -- Uses hand-made or custom-built cages to hold production catfish inside a pond, lake, or other body of water

   NOTE: Cage cultures solve harvest problems and are a good starting point in farming catfish.

3. Vat culture -- Uses tanks, or "vats," to hold the water source for production catfish

   NOTE: Vat cultures are sophisticated and extremely risky, and are still largely experimental in Oklahoma.

4. Raceway culture -- Uses a source of flowing water running from one "raceway" to another, made from a series of ponds or custom built from earth, concrete, or other materials

   NOTE: Raceway cultures may not be economical if water must be pumped, and few sources of assistance are available. Raceway cultures are sophisticated and extremely risky, and are still largely experimental in Oklahoma.

As a first-season catfish farmer, you will probably start out with a pond culture by adapting an existing pond, building a small pond, or using a cage culture Pond cultures and cage cultures usually have lower startup costs and lower risks. Therefore, vat and raceway cultures are not covered in detail in this Workbook.

Types of Market Opportunities

1. Sales Markets

   * Retail markets -- Roadside stands, restaurants, supermarkets, farmer's markets, pond bank sales (where customers buy your fish live from your pond), fingerling sales, etc.

   * Processing plants -- Buyers of large numbers of catfish for processing and selling

   * Recreational markets -- Fee-fishing operations, selling fish for stocking, sports clubs, etc.

   * Other markets -- Churches, local clubs and organizations, business groups, other farms, live haulers, etc.

   NOTE: Retail markets and processing plants are sales markets in which you must compete with large producers.

2. Non-Sales Markets -- Personal (home) use

B. Reviewing Basic Time Requirements and Costs

Time Requirements

Managing your fish and their environment

1. Managing water supplies
   * Collecting information about your water quality
   * Measuring oxygen levels
   * Preventing low dissolved oxygen
   * Predicting nighttime dissolved oxygen levels
   * Preventing off-flavor
   * Controlling weeds
2. Growing food fish (feeding)
   * Feeding your fish
   * Observing feeding patterns
3. Controlling catfish diseases and parasites
4. Controlling predators, trash fish, and pests

Managing your records

1. Stocking records
2. Feeding and weather records
3. Water chemistry records
4. Mortality records
5. Chemical treatment records
6. Harvest/sales records
7. Expense records
8. Bank and/or loan records
9. Aquatic culture records as required by the Department of Wildlife Conservation

NOTE: These records are explained in the "Application for Aquatic Culture License."

Some Elements of Successful Catfish Cultures

Management of successful catfish cultures includes . . .

_____ Identifying markets for your fish
_____ Identifying high-quality water sources
_____ Controlling dissolved oxygen levels
_____ Controlling off-flavor problems
_____ Controlling weeds
_____ Planning for pond or cage culture
_____ Recognizing signs of disease and parasites
_____ Following general guidelines for preventing, diagnosing and treating diseases and parasites
_____ Controlling predators, trash fish, and pests
_____ Using efficient harvest methods

Importance of Time Requirements

1. To identify and respond to possible problems every day

   NOTE: An unidentified problem could become a threat to the success of your operation or even lead to a loss of catfish (and money).

2. To adjust to changing conditions quickly

   NOTE: Conditions can change quickly and can require a quick response from the catfish farmer. For example, if the level of dissolved oxygen gets too low -- even overnight -- you could wake up to find all of your fish dead.

3. To protect your investment

   NOTE: Good management of your catfish culture includes caring for your investment every day. One day of poor management could ruin your investment.

4. To maximize the return on your investment

   NOTE: By managing your fish, their environment, and your records, you can get the most out of your investment of time and money.

5. To keep accurate records

Types of Costs*

Variable Costs (partial list)

1. Fingerlings
2. Feed
3. Custom harvesting (per pound)
4. Harvesting labor (per hour)
5. Tractor fuel (per hour)
6. Chemicals (per acre)
7. Water pumping

Fixed Costs (partial list)

NOTE: Items with an asterisk (*) have amortized lifespans. The years given are estimates.

1. Aquatic culture license (per year)
2. Tractor (*10 years)
3. Feed wagon and feed bin (*20 years)
4. Storage shed (*20 years)
5. Boat and motor (*10 years)
6. Harvesting equipment (*7 years)
7. Aerator (*per acre -- 10 years)
8. Oxygen test kit (*1 year)
9. Dip nets, waders (*1 year)
10. Cages (*per cubic foot -- 10 years)
11. Interest rate
12. Feed conversion efficiency
13. Well costs
14. MISCELLANEOUS fixed costs (*per acre -- 1 year)

*From questions used with a catfish production and marketing computer program at Langston University, Langston, Oklahoma.

Other Costs

1. **Loans** -- loans to provide the money needed to start a farming operation (money to buy equipment, pay for costs of construction if needed, etc)

2. **Taxes** -- taxes on your income from your farming operation

3. **Depreciation** -- costs of depreciation on the value of tools, equipment, and machinery

4. **Interest** -- interest expense on any loans

5. **Insurance** -- any insurance required on vehicles, property, etc

6. **Miscellaneous equipment**

C. Identifying Risks and Legal Considerations

Risks in Catfish Culture

1. Catfish diseases and parasites
   * Loss of some or all of your fish
   * Loss of time and money
2. Dissolved oxygen problems (low dissolved oxygen)
   * Loss of some or all of your fish
   * Loss of time and money
3. Water quality and quantity -- Low-quality water, from natural causes, pollution or contamination; not enough water
   * Loss of some or all of your fish
   * Loss of time and money

   NOTE: If you are dependent entirely on runoff water as your water source, you must use a large catch pond. A constant water supply could reduce your risks.
4. Low-quality catfish fingerlings
   * Costs of starting a farm using low-quality stock, such as fingerlings with disease or parasite problems
   * Inability of catfish to reach market size
   * Not cost-effective
5. Off-flavor
   * Loss of sales from poor flavor, if problem is not identified in time to correct before harvest
   * Added cost of keeping and feeding affected fish until the off-flavor is corrected
6. Predators, trash fish, and pests

7. Overstocking or understocking of ponds or cages

   * Poor growth with overstocking

   * Fighting among caged fish with understocking

8. Poor quality feed

   * Poor feed conversion

9. Market and/or price changes

   * Loss in sales from loss of a market or from lower-than-expected prices

   * Increase in sales from new markets or from higher-than-expected prices

10. Seasonal changes in the market demand for catfish

    * Loss or increase in sales from a loss or increase in demand

11. Theft

Preparing for Risks

1. Manage your fish and their environment every day

   NOTE: Lower the risks in catfish culture through daily management and prevention. You can detect problems early if you are observent.

2. Identify markets <u>before</u> starting a catfish farming operation

3. Look for new markets/buyers

   NOTE: New buyers can replace buyers who leave your area or who quit the market.

4. Be prepared for seasonal changes in market demand

   NOTE: You must be able to sell your fish when your markets want to buy.

5. Keep accurate records

   NOTE: Accurate daily records can help you identify problems early.

6. Use your estimated production costs, your profit, and the current prices for catfish in your identified markets to find the lowest price at which you could sell your fish

NOTE: Do not be surprised by price changes. Find a range of acceptable prices before you invest your time and money in catfish culture.

Legal Considerations and Regulators

1. Water resource considerations -- Regulated by the Oklahoma Water Resources Board

   * Waste disposal (from processing your fish) and waste disposal permits

   * Water rights

   * Water discharge or recirculation

   NOTE: See the "Important Addresses" pages in this book for more information.

2. Chemical considerations -- Regulated by the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA)

   * Registered or approved therapeutants for aquatic or fishery uses

   * Registered or approved anesthetics for aquatic or fishery uses

   * Registered or approved disinfecting agents for aquatic or fishery uses

   * Registered or approved water treatment compounds for aquatic or fishery uses

   * Registered or approved herbicides and algicides for aquatic or fishery uses

   * Registered or approved fish control agents for aquatic or fishery uses

   NOTE: See the "Suggested Reading" pages in this book for more information.

3. Tax considerations -- Regulated by state and federal government

NOTE: See the "Important Addresses" pages in this book for more information.

4. Protected wildlife considerations -- Regulated by state or federal government (in Oklahoma, through the Oklahoma Department of Wildlife Conservation)

   * Protected water birds (such as cormorants and pelicans)

   NOTE: Cormorants and pelicans can seriously damage your catfish culture by eating catfish and fingerlings. If the problem is serious, you must check with game rangers and get permission to control the birds. See the "Important Addresses" pages in this book for more information.

5. Aquatic culture license -- Regulated by the Oklahoma Department of Wildlife Conservation

6. Public health considerations -- Regulated by the Oklahoma Department of Health

   * Public health standards relating to catfish processing

WORKSHEET 1-1 -- Exploring Your Ideas about Catfish Culture

Instructions

1. Answer the questions on the Checklist

2. Use your answers as guidelines when thinking about your opportunities in catfish culture

   NOTE: Catfish culture can be a very successful business, and the demand for high-quality farm-raised catfish is growing. However, any successful catfish culture requires a commitment from the farmer every day.

WORKSHEET 1-1 -- Exploring Your Ideas about Catfish Culture

Checklist

		Yes	No
1.	What are your reasons for farming catfish:		
	a. growth of the market?	_____	_____
	b. availability of water?	_____	_____
	c. source of income?	_____	_____
	d. source of food?	_____	_____
2.	How would you describe your opportunities in catfish culture:		
	a. as a profit-making business, satisfying the needs of sales markets?	_____	_____
	b. as a hobby, a special interest, or just a source of extra food or income?	_____	_____
	c. as BOTH (a) and (b)?	_____	_____
3.	Will you personally have the time required EVERY DAY to manage your fish and their environment?	_____	_____
4.	Are you committed to managing the records required for a successful catfish culture?	_____	_____
5.	Will you have personal daily contact with your catfish?	_____	_____
	NOTE: Personal daily contact is required so that you can identify and respond to possible problems, adjust to changing conditions, and protect your investment.		
6.	Can you afford the variable costs, fixed costs, and any other costs of catfish culture?	_____	_____
7.	Can you reduce any of the costs by using your own existing equipment?	_____	_____
8.	Are you committed to spending your own money on catfish culture, before you make a profit?	_____	_____
9.	Can you accept the risks in catfish culture?	_____	_____
	NOTE: You can lower the risks in catfish culture through prevention and daily management.		

1. Thinking About Catfish Culture

Unit Review

1. Name four (4) reasons for farming catfish.

   a. _____

   b. _____

   c. _____

   d. _____

2. Describe methods of farming.

   a. Pond culture -- _____

   _____

   b. Cage culture -- _____

   _____

   c. Vat culture -- _____

   _____

   d. Raceway culture -- _____

   _____

   _____

3. Identify types of market opportunities.

   a. _____

   b. _____

4. State basic time requirements.

   Managing your fish and their environment

   a. _____

   b. _____

   c. _____

   d. _____

Managing your records

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

h. _____

i. _____

5. Explain the importance of time requirements by completing each of the sentences below.

a. To _____ and _____ to possible problems every day

b. To adjust to _____ conditions quickly

c. To protect your _____

d. To maximize the _____ on your investment

e. To keep _____ records

6. List some of the types of variable costs, fixed costs, and other costs.

Variable costs

a. _____

b. _____

c. _____

d. _____

e. _____

Fixed costs

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

h. _____

i. _____

j. _____

Other costs

a. _____

b. _____

c. _____

7. Identify risks in catfish culture by writing an X beside each risk.

_____a. Catfish diseases and parasites

_____b. Depreciation

_____c. Dissolved oxygen problems (low dissolved oxygen)

_____d. Water quality and quantity

_____e. Feeding your fish

_____f. Low-quality catfish fingerlings

_____g. Off-flavor

_____h. Controlling weeds

_____i. Predators, trash fish, and pests

_____j. Overstocking or understocking of ponds or cages

_____k. Water rights

_____l. Poor quality feed

_____m. Market and/or price changes

_____n. Seasonal changes in the market demand for catfish

_____o. Theft

8. Identify basic guidelines for preparing for risks by writing an X in the space beside each guideline.

_____a. Manage your fish and their environment as often as possible

_____b. Identify markets <u>after</u> starting a catfish farming operation

_____c. Manage your fish and their environment every day

_____d. Identify markets <u>before</u> starting a catfish farming operation

_____e. Look for new markets/buyers

_____f. Be prepared for yearly changes in market demand

_____g. Be prepared for seasonal changes in market demand

_____h. Use your estimated production costs, your profit, and the current prices for catfish in your identified markets to find the lowest price at which you could sell your fish

9. Name legal considerations.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

To check your answers, review the unit.

2. Marketing

Unit Objectives

After completing this unit, you should be able to

1. Define marketing in catfish culture
2. Describe the role of marketing in catfish culture
3. Identify types of markets
4. Match the types of markets to their advantages and disadvantages
5. Identify basic marketing questions
6. Find possible markets (WORKSHEET 2-1)
7. Identify types of operations
8. Describe basic considerations for marketing, pricing, and selling
9. Outline your marketing plan (WORKSHEET 2-2)
10. Match markets to operations (WORKSHEET 2-3)

2. Marketing

A. Identifying Markets for Your Fish

Definition

Marketing -- Getting your fish from your farm to your buyers, in a way that meets the needs of your buyers within the limits of your operations

Role of Marketing

* Catfish is your product for sale
* Marketing success can lead to sales success
* You must be able to find possible buyers for your catfish and be able to satisfy the needs of each buyer
* If you cannot identify and satisfy your buyers, then you will not sell many fish and make the highest possible return on your investment

Types of Markets

1. Retail markets

   EXAMPLE: Roadside stands, restaurants, supermarkets, farmer's markets, pond bank sales, and fingerling sales.

   NOTE: Restaurants and supermarkets usually require dressed fish. If you are selling to these retail markets, you should decide whether you can dress your fish and whether you want to dress your fish.

2. Processing plants

   NOTE: Processing plants are good markets for your fish after you have tried to identify other markets.

3. Recreational markets

   EXAMPLE: Fee-fishing operations, sports clubs, selling for stocking.

   NOTE: Fee-fishing operations require a high volume of fish that is hard for a small catfish operation to supply. However, small operations can supply sports clubs easily, because they require a smaller volume of fish.

4. Other markets

   EXAMPLE: Churches, local clubs and organizations, ethnic groups, business groups, other catfish farms, live haulers, etc.

NOTE: If you already produce catfish for yourself or for profit, then you should identify markets for your fish that you can satisfy with your existing operations. If you are planning to farm catfish, then you should identify markets that you can satisfy with your planned operations, or identify markets and plan your operations needed to satisfy those markets.

Market Advantages and Disadvantages

1. Retail markets

Advantages

* Offer generally higher prices
* Offer higher profit through direct sales
* Allow the farmer to determine the time of the sale
* Are good markets for selling live catfish

Disadvantages

* Require time to establish each market
* Do not provide a reliable volume of sales
* Can determine the return on investment by the location of the retail outlet
* Offer generally smaller volume of sales to each buyer
* Can involve competition with large producers

2. Processing plants

Advantages

* Guarantee a buyer for your catfish
* Move a large volume of fish
* Can serve as a "back-up" when other markets fail

Disadvantages

* Pay lowest prices
* Offer lower profit potential than retail markets

* Generally require a large shipment of catfish for custom harvesting and processing

3. Recreational markets

Advantages

* Offer high volume of sales

* Offer generally higher, mid-level prices (but lower than retail)

* Provide opportunity for sales from related facilities at the recreational site

Disadvantages

NOTE: Many of these disadvantages apply only if the recreational operation is on your property. You could sell catfish to recreational markets without operating your own recreational facility.

* Require constant supervision while site is open

* Require liability insurance

* Require greater market development

* Require separate ponds from the farm operation for catch-out

* Depend on successful advertising to attract customers

* Must assure a good "catch rate" for customer satisfaction in catch-out operations

* May require investment in related facilities for customer satisfaction, such as bait and tackle, food and beverage, dressing of fish, etc.

* Can be seasonal operations

4. Other markets

Advantages

* Can supplement larger markets

* Can reduce the need for long-distance transport of live fish through sales to local buyers

Disadvantages

* May offer a smaller volume of sales

* May be seasonal

Basic Marketing Questions

1. What is the type and size of your operation in surface acres and cubic feet of water available for catfish culture?

   NOTE: The type and size of your operation will help you outline a marketing plan.

2. Can you identify possible markets for your fish?

3. Can you supply enough fish to meet the current demand from each identified market?

   NOTE: The demand for your catfish can change. You must be able to respond to periods of high and low demand.

4. Can you "control" your markets?

   NOTE: You should avoid relying on one market only. You should find the best markets for your fish based on your investment and expected returns, then build a relationship with those markets.

5. At what time of year will your catfish sell?

   NOTE: Prices change and markets become full at different times of the year. Time is important. If you hold your fish too long, they might grow too large for your market(s).

6. At what size will your catfish sell?

   NOTE: You must be able to sell the size of fish that your buyers want.

7. Can you adjust to seasonal changes in the demand for your fish?

   NOTE: You must be able to sell your fish when your markets want to buy.

8. Can you adjust to price changes?

   CAUTION: IF YOU CANNOT AFFORD TO SELL YOUR CATFISH AT OR BELOW CURRENT PRICES, YOU SHOULD RECONSIDER YOUR OPTIONS IN CATFISH CULTURE.

9. Can you afford to advertise?

10. Is it efficient for you to sell catfish all year?

EXAMPLE: Your markets may want larger catfish than can be harvested at the end of one growing season.

WORKSHEET 2-1 -- Finding Possible Markets

Instructions

1. Consider how far you are willing and able to travel: within your immediate area, outside your immediate area, or both

2. Contact someone who represents each possible market (owner) to be sure that the market is a possible source of sales for your fish

   HINT: Visit each market, if possible.

   Sources of Market Information

   * Local markets that you know about, such as restaurants, supermarkets, farmer's markets, processing plants, other markets, etc.

   * Newspapers -- Which restaurants are advertising catfish on their menu?

   * Personal contacts -- What markets can you identify from your personal contacts or word-of-mouth?

   * Telephone books

   * Chambers of Commerce -- For clubs and organizations

3. List only the possible markets in the spaces for each

WORKSHEET 2-1 -- Finding Possible Markets

1. RETAIL MARKETS

Name	Address
_____	_____
_____	_____
_____	_____
_____	_____

2. PROCESSING PLANTS

Name	Address
_____	_____
_____	_____
_____	_____
_____	_____

3. RECREATIONAL MARKETS

Name	Address
_____	_____
_____	_____
_____	_____
_____	_____

4. OTHER MARKETS

Name	Address
_____	_____
_____	_____
_____	_____
_____	_____

B. Describing Common Operations and Market Needs

Types of Operations

1. Pond culture -- Uses natural or constructed ponds that are seinable and drainable

   EXAMPLE: Watershed ponds, levee ponds, or specially-designed and built ponds. All ponds must meet specific standards for successful catfish production.

2. Cage culture -- Uses hand-made or custom-built cages to hold production catfish inside a pond, lake, or other body of water

   NOTE: Cage cultures solve harvest problems and are a good starting point in farming catfish.

3. Vat culture -- Uses tanks, or "vats," instead of ponds to hold the water source for production catfish

   NOTE: Vat cultures are sophisticated and extremely risky, and are still largely experimental in Oklahoma.

4. Raceway culture -- Uses a source of flowing water running from one "raceway" to another, made from a series of ponds or custom-built from earth, concrete, or other materials

   NOTE: Raceway cultures may not be economical if water must be pumped, and few sources of assistance are available. Raceway cultures are sophisticated and extremely risky, and are still largely experimental in Oklahoma.

As a first-season catfish farmer, you will probably start out with a pond culture by adapting an existing pond, building a small pond, or using a cage culture.

Pond cultures and cage cultures usually have lower start-up costs and lower risks. For this reason, vat and raceway cultures are not covered in more detail in this book

Basic Considerations

Marketing considerations

1. Product -- Offer high-quality healthy catfish that are the right size for each market

2. Price -- Sell your catfish at the price that your buyers are willing to pay and the price that you can afford

   NOTE: What are the current prices for catfish in your area for different markets?

3. Place -- Have your catfish at the right places for sale (where your buyers are or are willing to go)

4. Promotion -- Advertise your catfish to bring your product and your buyers together

Pricing considerations

1. Production costs

   EXAMPLE: Feed and feeders, water supply, equipment, harvesting equipment, time, etc.

2. Profit

   NOTE: How much profit do you need to make your operation a success?

3. Current prices (wholesale and retail) for your identified markets

   NOTE: You should talk with catfish farmers, retail outlets, processors, and others for information about current prices.

4. Sales price (production costs plus profit)

   NOTE: How does your sales price compare with current prices in your identified markets?

Selling considerations

1. Affordable price -- Sell at the price that you and your buyers can afford

2. Advertising -- Bring your buyers and your product together

   NOTE: You will not be successful if your buyers do not know about your product!

3. New markets -- Look for new markets to help your operation grow

   NOTE: New buyers can replace other buyers who leave your area or who quit the market for some reason.

4. High-quality product

   NOTE: Poor-quality fish will reduce your numbers of buyers, no matter how much you advertise.

5. Buyer satisfaction -- Respond to the needs and complaints of your buyers

WORKSHEET 2-2 -- Outlining Your Marketing Plan

Instructions

1. Choose the market(s) from WORKSHEET 2-1 to which you want to sell

   HINT: You may decide to shorten your list from WORKSHEET 2-1.

2. Answer the questions in this WORKSHEET for each of the markets that you have chosen (from WORKSHEET 2-1)

   HINT: Get the answers to many of the questions from the representatives of each market.

3. Write your answers on the "Marketing Plan" at the end of this WORKSHEET for each chosen market

WORKSHEET 2-2 -- Outlining Your Marketing Plan

RETAIL MARKETS

1. Product --

   a. How many pounds of fish does each market want?

   b. What size catfish does each market want?

   c. When does each market want your fish? Weekly? Monthly?

   d. How will each market accept your fish? Live? Dressed?

   e. Can you supply all of the market's needs yourself? As a joint venture with other farmers?

2. Price -- What are the current prices for catfish at each market?

   HINT: Check each possible market for the current range of prices (lowest and highest).

3. Place --

   a. Where and how often must you deliver your fish to each market?

   b. Can you afford the time and labor to sell your fish from a roadside stand or pond bank?

4. Promotion --

   a. How can you advertise for each market?

      EXAMPLE: Local radio, local newspapers, classified advertising, signs, posters, handouts, etc.

   b. Will retail outlets (such as restaurants or stores) advertise your fish for sale? How will they advertise?

   c. How and where can you advertise to attract customers to roadside stands or pond banks?

WORKSHEET 2-2 -- Outlining Your Marketing Plan

PROCESSING PLANTS

IMPORTANT: Plan your operations with any processors in advance.

1. Product --

   a. How many pounds of fish will the plant buy from you?

   b. What size catfish does the plant want?

   c. What is the minimum load required by the plant?

   d. When will the plant take your fish (times of the year)?

   e. How and when does the processor check the quality of your fish (check for off-flavor)?

2. Price --

   a. What average price per pound can you expect to be paid?

   b. What are the purchasing procedures followed by the processing plant? (flavor analysis, weighing, pricing, etc.)

3. Place --

   a. Is your farm within the range of the plant's harvesting crew? If not, can you harvest the fish yourself (equipment, labor, money, transport, time, etc.)?

      NOTE: If you are harvesting your own fish, can you harvest at least 90% of your fish to recover your costs?

   b. Does your operation meet the requirements of the plant for harvesting? (Accessibility, etc.)

   c. What are the responsibilities of the processing plant and the farmer (as outlined by the processing plant)?

4. Promotion -- How far in advance must you arrange for the sale of your fish (when must you first contact the plant)?

WORKSHEET 2-2 -- Outlining Your Marketing Plan

RECREATIONAL MARKETS

1. Product --

   a. What is the demand for fee-fishing in your area? (Do other operations already exist? Where are they?)

   b. What size catfish does each market want?

   c. How many fish will existing recreational operations buy from you (to supply stock for their operations)?

   d. What size fish do existing operations want?

2. Price --

   a. What are the current fees assessed per day, per pound, etc., for fee-fishing operations?

   b. How much will existing recreational operations pay for your stock?

   c. Will the payment offered by existing recreational operations cover your costs plus profit?

3. Place --

   a. Who is responsible for transporting your fish to existing recreational operations for sale/delivery?

   b. Who are your potential customers? Where are they (Is your operation located close to your customers)?

   c. Is your operation located for easy access by your potential customers?

   d. Can you manage your own recreational operation?

   NOTE: Your management concerns will include constant supervision of the operation while it is open, protection of your fish against theft, customer safety, etc.

4. Promotion --

   a. How can you advertise for your own recreational operation?

   EXAMPLE: Local radio, local newspapers, classified advertising, signs, posters, handouts, etc.

   b. Where can you place signs to advertise your own recreational operation?

WORKSHEET 2-2 -- Outlining Your Marketing Plan

OTHER MARKETS

1. Product --

   a. How many pounds of fish does each market want?

   b. What size catfish does each market want?

   c. How often will each market want your fish?

      NOTE: You may be able to sell to these "other markets" in addition to any markets that you have identified.

   d. How will each market accept your fish? Live? Dressed?

2. Price --

   a. How much will each market pay?

   b. Can you cover your costs plus profit?

3. Place --

   a. Who are your potential customers? Where are they?

   b. How will you reach your customers for the sale? (Delivery, pick-up, etc.)

4. Promotion --

   a. How can you advertise for your "other" markets?

      EXAMPLE: Local radio, local newspapers, classified advertising, signs, posters, handouts, etc.

WORKSHEET 2-2 -- Outlining Your Marketing Plan

Marketing Plan
(Copy for each market)

Market: _____

1. Product

_____

_____

_____

_____

_____

2. Price

_____

_____

_____

_____

_____

3. Place

_____

_____

_____

_____

_____

WORKSHEET 2-2 -- Outlining Your Marketing Plan

Marketing Plan

Market: _____

4. Promotion

_____

_____

_____

_____

_____

WORKSHEET 2-3 -- Matching Markets to Operations

Instructions

1. Compare your existing or planned operation with your possible markets

2. Using the "Basic Marketing Questions" and your Marketing Plan for each possible market as guides, list the markets that match your abilities and the production possibilities of your operation

   NOTE: Your markets determine your options in catfish culture. You should be able to satisfy more than one type of market.

3. Get a firm commitment from each market, if possible

   NOTE: You may not be able to get a firm commitment from possible markets. Also, a buyer may decide not to buy your catfish, even after you are ready to sell. Consider processing plants as a "way out" if you cannot get a firm commitment from other markets.

4. Use this WORKSHEET as a starting point -- Build a relationship with your markets

WORKSHEET 2-3 -- Matching Markets to Operations

RETAIL MARKETS (Names and Addresses)

PROCESSING PLANTS (Names and Addresses)

RECREATIONAL MARKETS (Names and Addresses -- If you plan to start your own recreational operation, then list your name and address)

OTHER MARKETS (Names and Addresses)

2. Marketing

Unit Review

1. Define marketing in catfish culture.

_____

_____

_____

2. Describe the role of marketing in catfish culture.

_____

_____

_____

_____

3. Identify types of markets by writing the number on the right that matches the description on the left.

_____a.	Fee-fishing operations, selling fish for stocking, sports clubs, etc.	1. Processing plants
_____b.	Roadside stands, restaurants, supermarkets, farmer's markets, pond bank sales, fingerling sales, etc.	2. Recreational markets
_____c.	Churches, local clubs and organizations, ethnic groups, business groups, other catfish farms, live haulers, etc.	3. Other markets
_____d.	Good markets for your fish after you have tried to identify other markets	4. Retail markets

4. Match the types of markets to their advantages and disadvantages by writing the number on the right that matches the statement on the left.

_____a.	Offer generally higher prices	1. Retail markets
_____b.	Guarantee a buyer for your catfish	2. Processing plants
_____c.	Require separate ponds from the farm operation for catch-out	3. Recreational markets
_____d.	Move a large volume of fish	4. Other markets
_____e.	Provide opportunity for sales from related facilities at the site	

_____f. Require liability insurance

_____g. Are good markets for selling live catfish

_____h. Can determine the return on investment by the location of the outlet

_____i. Pay lowest prices

_____j. Can be seasonal operations

_____k. Generally require a large shipment of catfish for custom harvesting and processing

_____l. Require constant supervision while site is open

_____m. Can supplement larger markets

5. Identify basic marketing questions by writing an X in the space beside each of the basic marketing questions.

_____a. What is the type and size of your operation in surface acres and cubic feet of water available for catfish culture?

_____b. When did you last drain or seine your pond?

_____c. Can you identify possible markets for your fish?

_____d. Can you supply enough fish to meet the current demand from each identified market?

_____e. How and when did you collect your fish samples?

_____f. Can you "control" your markets?

_____g. At what time of year will your catfish sell?

_____h. At what size will your catfish sell?

_____i. Is the land site clear of obstructions?

_____j. Do your existing ponds have a uniform shape?

_____k. Can you adjust to seasonal changes in the demand for your fish?

_____l. Can you adjust to price changes?

_____m. Do you know the history of the land site?

_____n. Can you afford to advertise?

_____o. Is it efficient for you to sell catfish all year?

6. Identify types of operations.

   a. _____

   b. _____

   c. _____

   d. _____

7. Describe each basic consideration for marketing.

   a. Product -- _____

   _____

   b. Price -- _____

   _____

   c. Place -- _____

   _____

   d. Promotion -- _____

   _____

8. Identify four (4) pricing considerations.

   a. _____

   b. _____

   c. _____

   d. _____

9. Identify five (5) selling considerations.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

To check your answers, review the unit.

3. Managing Water Supplies

Unit Objectives

After completing this unit, you should be able to

1. Match the types of water sources to their advantages and disadvantages
2. List requirements of water sources
3. Identify elements of water quality
4. List sources of information about water quality
5. Identify your water source(s) (WORKSHEET 3-1)
6. Collect information about your water quality (WORKSHEET 3-2)
7. Define dissolved oxygen
8. Explain the importance of controlled dissolved oxygen levels
9. Describe the daytime and nighttime levels of dissolved oxygen
10. Name some problems with low dissolved oxygen
11. Identify basic guidelines for measuring oxygen levels
12. Identify basic guidelines for preventing low dissolved oxygen
13. Check for signs of low dissolved oxygen (WORKSHEET 3-3)
14. Predict nighttime dissolved oxygen levels in ponds (WORKSHEET 3-4)
15. Define stratification, destratification, and biological oxygen demand
16. Identify sources of high BOD
17. Identify periods of overturn
18. Define off-flavor
19. Identify off-flavor expenses
20. List signs of off-flavor

21. Identify basic guidelines for preventing off-flavor

22. Name problems with weeds

23. Distinguish among types of weeds

24. Match the methods of weed control to their advantages and disadvantages.

25. Identify basic guidelines for controlling weeds

3. Managing Water Supplies

A. Identifying High-Quality Water Sources

Types of Water Sources

1. Well water

Advantages

* Is your best source of water, if economical
* Does not have problems with trash fish, pesticides, flooding, etc.

Disadvantages

* Can become contaminated with ammonia compounds and pesticides
* May involve more legal restrictions
* Has a low level of dissolved oxygen (DO), requiring aeration to improve DO level
* Usually contains harmful gases and minerals
* Adds the costs of pumping the water from the well

2. Spring water

Advantages

* Usually maintains a constant temperature
* May not need a pumping system

Disadvantages

* Does not have a constant flow -- rate of water flow may vary

  NOTE: You might not get the volume of water that you need <u>when</u> you need it.

* Usually has a low level of dissolved oxygen (DO), requiring aeration to improve DO level
* Usually contains harmful gases
* May involve more legal restrictions

3. Stream-fed

Advantages

* May supply your needed volume of water

* Pumping costs may be lower (because water may not have to be raised)

Disadvantages

* Does not provide a constant volume of water

  NOTE: The volume of water may change, depending on the time of year and other conditions.

* Can contain trash fish

* Can become contaminated from upstream and other sources

  NOTE: The quality of the water can change, depending on the time of year and the level of pollutants.

* Involves legal restrictions

* Has a high flood potential

* Is a constant source of disease

4. Surface run-off

Advantages

* Is a free source of water

Disadvantages

* Cannot by itself supply your needed volume of water

  NOTE: Relying on surface runoff as your only source of water is very risky.

* Does not provide a constant volume of water

  NOTE: The amount of water from surface run-off varies with the season.

* Can become contaminated by pesticides in the soil, and from other pollution

* Requires a large catch pond

* Adds silt to your water

Requirements of Water Sources

1. Provide 20-50 gallons per minute (gpm) per surface acre (not a constant flow)

   NOTE: The volume of water needed for pond cultures is usually measured in "acre-feet." One acre-foot is the amount of water needed to fill one acre one foot deep. If your pond covers 15 surface acres and averages 5 feet deep, then you would need about 75 acre-feet of water (15 X 5) to fill the pond.

2. Fill your pond to the level you need and flush your pond of wastes and other contamination

   NOTE: If you use your pond(s) year-round, consider a required volume of water that is three times as much as your pond(s) will hold.

3. Replace water lost through evaporation or seepage

   NOTE: Can your soil hold water? Check the Soil Survey books for your county to determine the permeability (water-holding ability) of your soil. These books are available from the Soil Conservation Service.

4. Provide all of the elements of water quality needed for catfish culture

Elements of Water Quality

1. Dissolved oxygen -- At least 5-6 parts per million (ppm)

   NOTE: See Section B, "Controlling Dissolved Oxygen Levels."

2. Temperature

Importance of Water Temperature

* Controls fish metabolism and rate of digestion -- For each one degree (Celsius) change in temperature, metabolism changes ten percent (10%)
* Influences feeding activity -- Most fish reduce or stop feeding when the water temperature is above 90 degrees F
* Affects growth -- Temperatures below 70 degrees F (approximately) reduce the growth rate of your fish
* Controls dissolved oxygen levels -- The higher the water temperature, the lower the amount of dissolved oxygen (DO) the water can hold
* Affects stress levels -- Stress levels of warmwater fishes are higher when the water temperature is above 90 degrees F (stress can increase the vulnerability of fish to diseases)
* Affects the ability of fish to fight diseases and parasites -- At lower temperatures, fish are weaker and slower
* Can influence the effectiveness of disease treatments

3. Alkalinity -- Helps to buffer changes in pH and helps prevent great fluctuations in pH levels

   Levels -- From 20 to 250 parts per million (ppm)

   NOTE: Alkalinity is an element of water quality that you must live with. It is too expensive to control.

4. pH -- A measure of the acidity or alkalinity of your water

   * Measures the acidity or alkalinity of your water on a scale of 0 to 14
   * Kills fish at or above pH 11 and at or below pH 4 (approximately)
   * Is best for catfish culture between pH 6.5 and pH 8.5
   * Always changes and follows a 24-hour cycle, reaching its highest levels in the afternoon
   * Can kill your fish when high pH (above 8) combines with high total ammonia levels

     CAUTION: WATCH AMMONIA LEVELS CAREFULLY IF PH IS HIGH.

   * Can slow the growth of your fish below pH 6.5

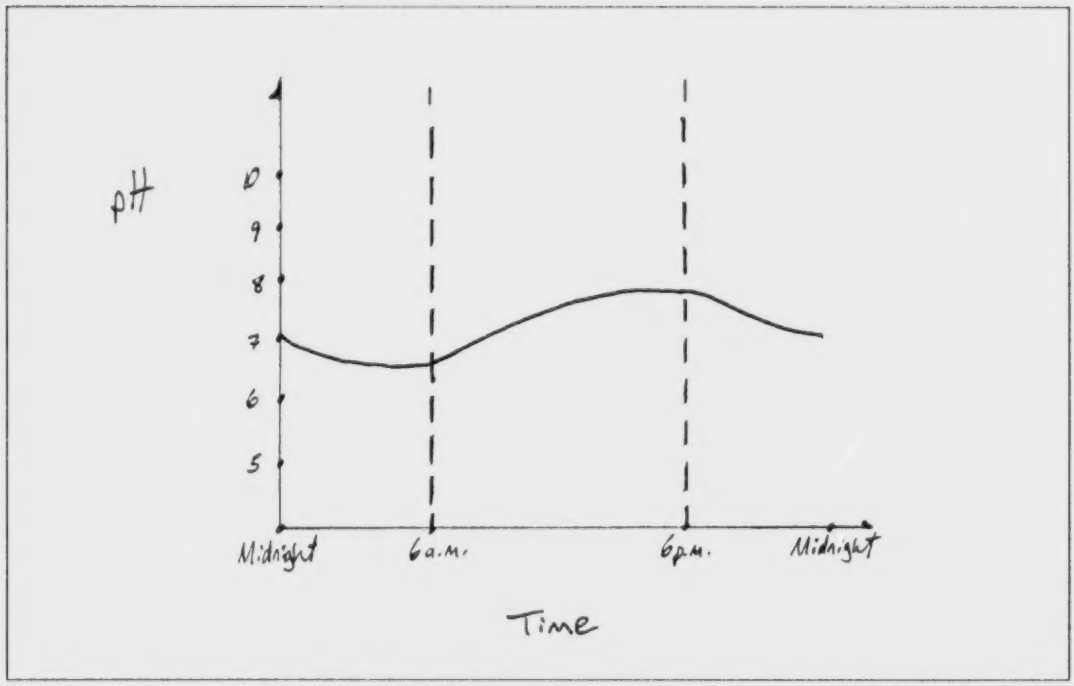

Figure 3-1. The general cycle of pH levels in ponds (every 24 hours).

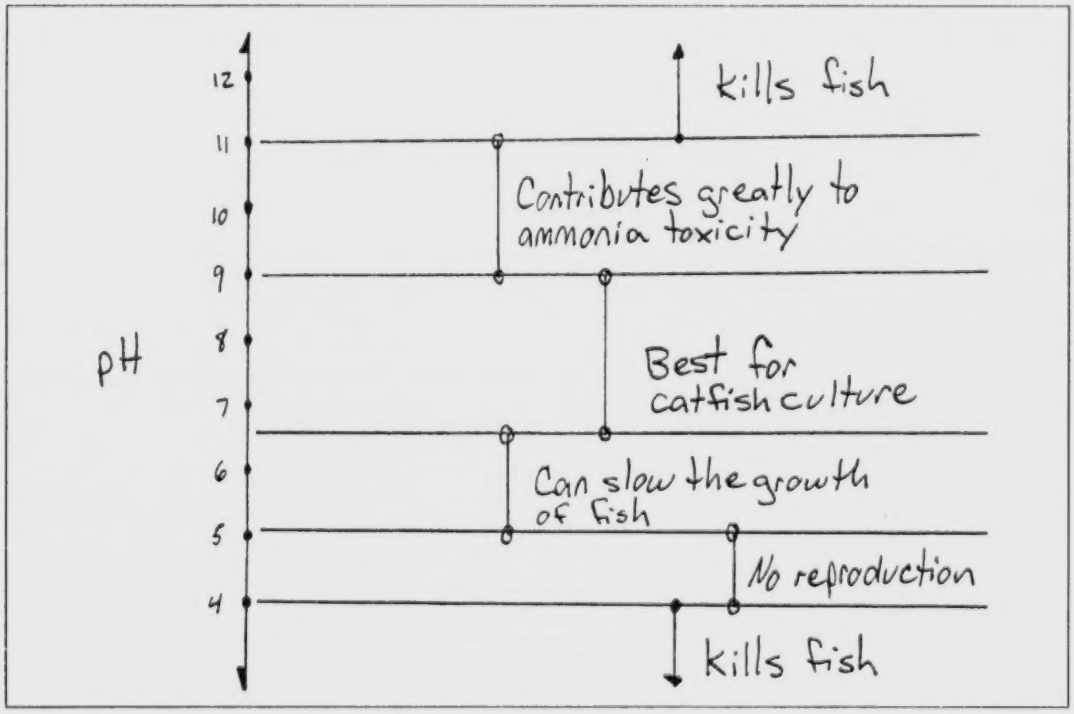

Figure 3-2. The importance of pH levels. The "best" range for catfish culture depends on the alkalinity of the water.

5. Water purity -- Free of pesticides, toxic (poisonous) materials, and other sources of contamination or pollution

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Some Common Sources of Pesticides

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* Surface runoff
* Drainage ditches (back-filling)
* Surface water
* Water from shallow wells
* Crop spraying from nearby fields
* Livestock spraying for flies and ticks -- Livestock may try to rinse themselves off in your pond

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6. Ammonia

   * Measured in parts per million (ppm) called Total Ammonia Nitrogen (TAN)

     NOTE: TAN includes both ammonia (toxic to fish) and ammonium (non-toxic to fish).

   * Can be very toxic to catfish in cold water (below 40 degrees F)

   * Common sources of ammonia include feed, plant and animal wastes, the breakdown (decay) of dead plants and animals, and incoming water

   * Amount of toxic ammonia in TAN increases with higher levels in pH and higher water temperature

   * Usually becomes toxic during warm, clear afternoons (when pH levels are higher), and happens most often in holding or hauling facilities

Some Signs and Possible Solutions for Ammonia Toxicity

Signs

* Skin hemorrhage -- Shown by red blotches on skin
* Gill hemorrhage -- Shown by bleeding when the gills move
* Fish gather together around inflowing water or at the edge of the pond
* Fish may appear lazy and slow-moving
* Fish may lie on the bottom or swim slowly near the surface or along the bank
* Gills may be red, swelled, and flared
* Fish look sick in the afternoon and improve by daybreak (in water with low alkalinity)
* Fish are not affected by aeration

Possible Solutions

* Use paddlewheel aerators during warm, sunny weather
* Flush all ponds
* Reduce feeding rates

Sources of Information

1. Water analysis

   NOTE: Get a complete water analysis of your water at its source before using any water source for catfish culture. Check with your local water treatment plant or water quality lab.

2. Chemical test kits

   NOTE: A partial list of suppliers is found in Water Quality Management for Fish Farmers by Conrad Kleinholz. See the "Suggested Reading" pages.

3. County extension agents

   NOTE: See the "Important Addresses" pages.

4. Soil Conservation Service or your county office of the Soil Conservation District

   NOTE: See the "Important Addresses" pages.

5. Oklahoma Water Resources Board

   NOTE: See the "Important Addresses" pages.

WORKSHEET 3-1 -- Identifying Your Water Source(s)

Instructions

1. Analyze your water source(s) for catfish culture

2. Contact the Oklahoma Water Resources Board for information about water rights, permits, and other information before you use the water

   Oklahoma Water Resources Board
   P.O. Box 53585
   1000 NE 10th St.
   Oklahoma City, OK 73152
   (405) 271-2555

3. Get the answers to the WORKSHEET questions (and any others) when you contact the Water Resources Board

WORKSHEET 3-1 -- Identifying Your Water Source(s)

1. What possible water sources can you find for your operation?

2. What permits are required for using and discharging water in a commercial fish farm?

3. How much water are you allowed to use? How much water do you need?

   Allowed:

   Need:

4. Can you recirculate the water, to reduce the volume you need?

5. Who has the rights to the water source(s) that could supply your operation?

6. Who has the first rights to the water source(s)?

7. How can you maintain your rights to water sources?

WORKSHEET 3-2 -- Collecting Information about Your Water Quality

Instructions

1. Get a complete water analysis from your local water treatment plant or water quality lab

   CAUTION: BE SURE THAT YOUR WATER HAS THE ELEMENTS OF HIGH-QUALITY WATER FOR CATFISH PRODUCTION, BEFORE YOU EVER START YOUR CATFISH OPERATION. CHECK FOR LEVELS OF IRON, ZINC, COPPER, MANGANESE, AND OTHERS.

2. Contact your county extension agent or the Soil Conservation Service, and use chemical tests to collect the WORKSHEET information about your water quality

   NOTE: Keep records of this information every day. Accurate records can help you identify problems early.

3. Record your information from several sites in the same pond, and collect information from each of your ponds every day

   NOTE: Water currents and wave action can cause your water quality to vary from one site to another.

4. Keep this Water Quality Record as a part of your permanent recordkeeping system

Other factors influence the usability of your water for catfish culture, such as nitrogen, carbon dioxide, and hydrogen sulfide. Check with experts about the quality of your water before you start your catfish farming operation, large or small. See the "Important Addresses" and "Suggested Reading" pages in this book.

WORKSHEET 3-2 -- Collecting Information about Your Water Quality

WATER QUALITY RECORD

NOTE: Record this information at several sites in the same pond.

DATE_____ LOCATION_____

		Site 1	Site 2	Site 3	Site 4
1.	Dissolved Oxygen (in ppm)				
	Dawn	_____	_____	_____	_____
	Afternoon	_____	_____	_____	_____
	Evening	_____	_____	_____	_____
2.	Temperature (range in degrees F)				
	At the surface	_____	_____	_____	_____
	At the bottom	_____	_____	_____	_____
3.	Alkalinity (in ppm)	_____	_____	_____	_____
4.	pH (on scale of 0-14)	_____	_____	_____	_____
5.	Ammonia (in ppm)	_____	_____	_____	_____

B. Controlling Dissolved Oxygen Levels

Definition

Dissolved oxygen (DO) -- the amount of oxygen that is dissolved in water, measured in parts per million (ppm) or milligrams per liter (mg/L)

Importance of Controlled DO Levels

1. Fish need dissolved oxygen to live and grow

2. Levels below 1-2 ppm will kill your fish

3. Levels below 5-6 ppm can reduce the levels of feeding and growth

4. Microscopic water plants (such as phytoplankton) and macrophytes (larger, leafy water plants with roots) affect dissolved oxygen levels

   NOTE: Microscopic water plants are <u>necessary</u>, but macrophytes are <u>dangerous</u> to fish cultures.

5. Low DO levels require some kind of aeration to return the water to safe levels

   NOTE: Vat cultures are especially vulnerable to low levels of dissolved oxygen, and require constant aeration and a dependable power supply -- if the power supply fails for any length of time, all of your fish (and your investment) will quickly die.

Daytime and Nighttime Levels

1. During the day -- Microscopic water plants produce oxygen during the process of photosynthesis. Photosynthesis requires sunlight. During the day, the level of dissolved oxygen is <u>higher</u> (8-14 ppm or higher)

2. At night -- During the night, plants use oxygen from the water, so the level of dissolved oxygen in the water decreases until daylight, when photosynthesis starts again

   NOTE: The lowest DO level is normally at <u>dawn</u>.

NOTE: Other factors influence the level of dissolved oxygen in the water. See the "Causes and Signs of Low Dissolved Oxygen."

Problems with Low Dissolved Oxygen

1. Kills fish

   NOTE: Low dissolved oxygen kills your larger fish first.

2. Causes stress in fish

3. Temporarily reduces the amount of food eaten by fish, if your fish are not exposed to low levels of dissolved oxygen very often

4. Reduces the levels of feeding, feed conversion, and growth

5. Affects fish in different cultures differently

   NOTE: Catfish in cages or vats cannot go to a better area with a higher DO level, such as near an aerator or inlet, while catfish in pond cultures can move around to these areas.

6. Increases the amount of carbon dioxide and ammonia in the water

   CAUTION: CARBON DIOXIDE AND AMMONIA ARE TOXIC TO YOUR FISH.

7. Increases the vulnerability of your fish to diseases

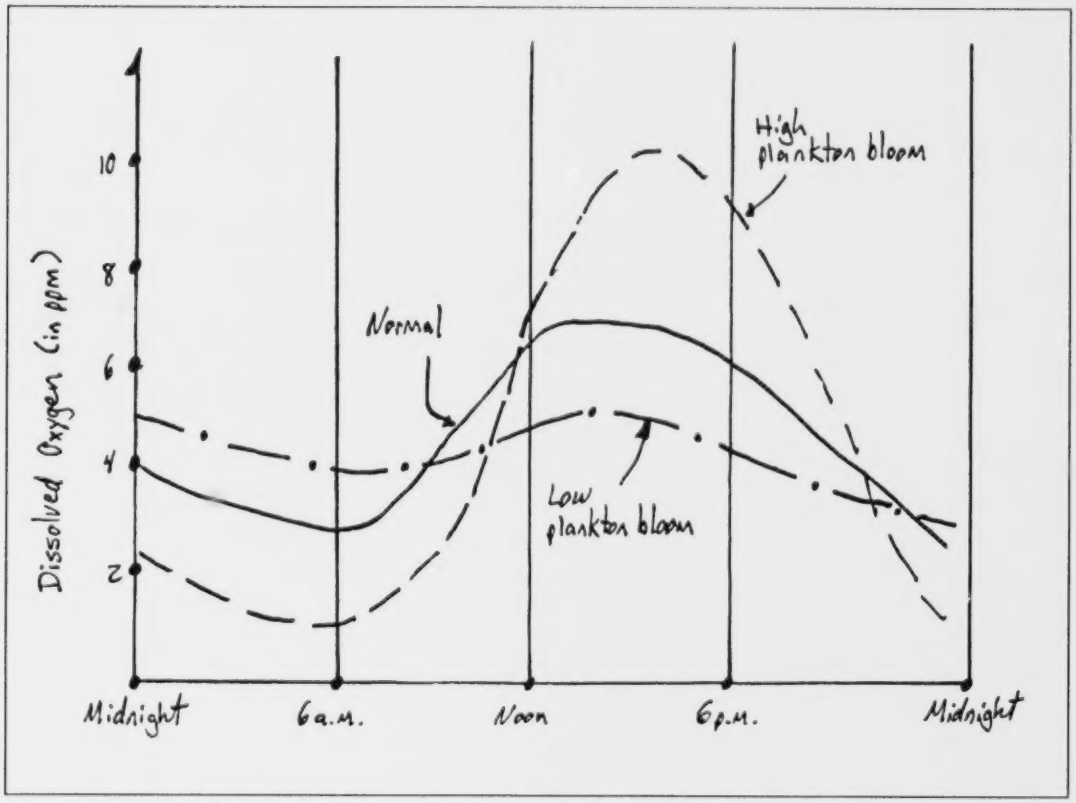

Figure 3-3. The general cycle of dissolved oxygen levels in ponds (every 24 hours).

Causes and Signs of Low Dissolved Oxygen

Causes

* Excessive growth of phytoplankton ("bloom") and/or macrophytes
* Overfeeding
* Several cloudy days in a row -- reduces the amount of oxygen produced by phytoplankton
* Several calm, hot nights in a row -- can cause algae to die-off, resulting in a lower level of dissolved oxygen produced
* Higher water temperatures -- water holds less oxygen at higher temperatures
* Runoff of manures, excess feeds, and plant materials into your pond -- when these organic materials are broken-down, the level of dissolved oxygen is reduced
* Destratification -- when the surface water mixes with the oxygen-poor bottom water, depending on light penetration and water density
* Fish wastes and wasted feed

Signs

* Any sudden changes in the water
* Low DO readings
* Sudden algal or bloom die-off
* Fish "gulping air" at the surface
* Film on the surface, or a strong odor and evidence of decayed plants and algae
* Reduced feeding activity
* Fish gathered near inlets and aerators
* Tadpoles gulping or popping to the surface rapidly
* Supersaturation in mid-afternoon

Measuring Oxygen Levels

1. Visually check for signs of low DO levels

   NOTE: Look for the signs of low dissolved oxygen every day in early morning and between dusk and dark. Also check whenever you think that a problem exists.

2. Check the DO level at first light (when the dissolved oxygen level will be lowest in its 24-hour cycle) -- If the DO level is low, check again in the afternoon

   CAUTION: IF THE LEVEL IS VERY LOW OR SUPERSATURATED IN THE AFTERNOON, CHECK AT DUSK AND AGAIN ABOUT 2 HOURS LATER.

3. Check the level of dissolved oxygen in at least two places each time in each pond, on the upwind and downwind sides

NOTE: To check DO levels, you could look for visual signs of low DO, use chemical test kits, or oxygen meters. Use the method that works for you.

4. Predict nighttime periods of low dissolved oxygen

5. Be ready to correct any problems with DO levels

NOTE: Know the real cause of the low DO level before you correct the problem. For example, reduced feeding activity may result from other problems in addition to low dissolved oxygen.

Preventing Low Dissolved Oxygen

1. Pump fresh oxygenated water into ponds with low DO levels

NOTE: Pump fresh oxygenated water from the surface, not from the bottom.

2. Control macrophytes and rooted plants

NOTE: See Section E for ways to control weeds.

3. Control phytoplankton bloom

NOTE: A Secchi disk or similar method can help you find the density of the phytoplankton bloom.

4. Watch the feeding activity of your fish

NOTE: Adjust your feeding practices if the dissolved oxygen reaches an unsafe level. Uneaten feed can contaminate the water and can lower the pond's DO level.

5. Aerate or recirculate the water in emergencies or continually

NOTE: Aerate or recirculate in emergencies to prevent or reduce fish die-off, or continually to help prevent problems with low dissolved oxygen. Aerate or recirculate immediately whenever the level of dissolved oxygen reaches 3 ppm.

CAUTION: IF THE DISSOLVED OXYGEN LEVEL GOES DOWN 2 OR 2 1/2 PPM PER HOUR, AERATE THE WATER IMMEDIATELY. HOWEVER, THE DISSOLVED OXYGEN LEVEL WILL PROBABLY CONTINUE TO DECREASE BEFORE IT INCREASES. THIS "SAG" HAPPENS BECAUSE THE AERATION MIXES THE SURFACE WATER WITH THE BOTTOM WATER, WHICH HAS A LOWER DISSOLVED OXYGEN LEVEL. YOU MAY LOSE SOME FISH BEFORE THE DISSOLVED OXYGEN REACHES A SAFE LEVEL.

Ideas for Aerating Water Supplies

Running water -- Add running water or circulate the water using a waterfall, spraying the water, flowing the water over a screen, agitating the water with a boat motor or brush hog, or other ways of circulating the water.

Wind Action -- Wind creates waves and aerates the water naturally (but not enough to rely on wind action alone).

Aerators -- Commercial propeller-driven pumps, paddlewheels, and other aerators for pond and cage cultures. Prices vary. Some aerators, such as paddlewheels, can be handmade.

Agitators -- Commercial paddle-driven aerator for holding tanks to "agitate" the water and provide oxygen (over a small area). Prices vary. Agitators are not enough for aerating ponds.

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6. Maintain safe water temperatures

   NOTE: At higher temperatures, water holds less dissolved oxygen.

7. Limit the runoff of manures, excess feed, and plant materials

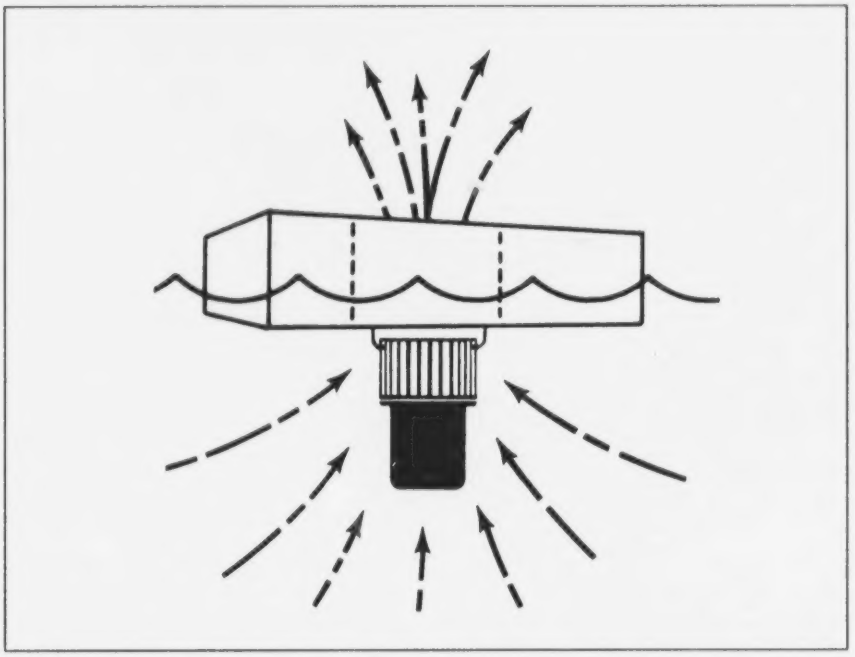


Figure 3-4. How a propeller-driven aerator works. (From Kasco Marine, Inc., Lakeland, MN)

Figure 3-5. A home-built paddlewheel aerator, motor-driven.

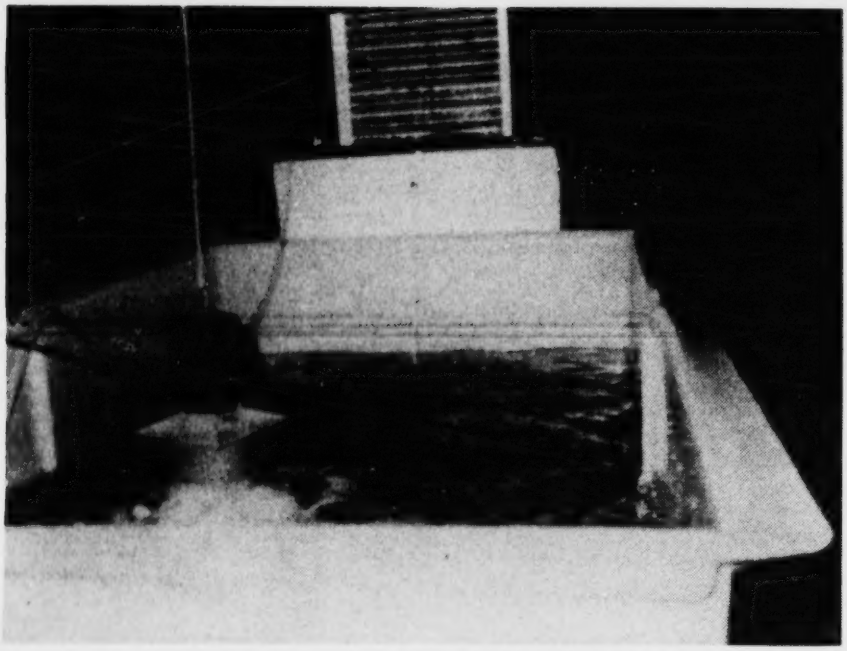


Figure 3-6. An agitator (suspended in a vat).
(From Boatcycle Manufacturing and Chemical, Henderson, TX)

WORKSHEET 3-3 -- Checking for Signs of Low Dissolved Oxygen

Instructions

1. Copy the "Dissolved Oxygen Record" to record any signs of low dissolved oxygen every day for every pond

2. Keep this Record with your "Water Quality Record"

   NOTE: This Record should be a part of your permanent recordkeeping system, along with your Water Quality Record.

3. Design your own "Dissolved Oxygen Record", if needed

   EXAMPLE: You might decide to combine your "Dissolved Oxygen Record" with your "Water Quality Record."

WORKSHEET 3-3 -- Checking for Signs of Low Dissolved Oxygen

DISSOLVED OXYGEN RECORD

NOTE: This checklist may not be complete and may not suggest any of the causes of low dissolved oxygen in your water supply.

DATE _____ LOCATION _____

SIGNS OF LOW DISSOLVED OXYGEN	YES	NO
1. Low DO readings from chemical or meter tests?	_____	_____
2. Sudden algal or bloom die-off?	_____	_____
3. Fish "gulping air" at the surface?	_____	_____
4. Film on the surface?	_____	_____
5. Strong odor/evidence of decayed plants and algae?	_____	_____
6. Color change in one day?	_____	_____
7. Reduced feeding activity?	_____	_____
8. Fish gathered near inlets and aerators?	_____	_____
9. Tadpoles gulping or popping to the surface rapidly?	_____	_____

NOTES

_____

_____

_____

_____

WORKSHEET 3-4 -- Predicting Nighttime Dissolved Oxygen Levels in Ponds

Instructions

1. Study the example

   NOTE: The DO level usually goes down at a constant rate (in a straight line) at night. However, remember that other factors can influence the change in the DO level.

2. On the blank graph, plot the two numbers given for the measured levels of dissolved oxygen in each Problem

3. Connect the two points in each Problem with a straight line through the points. Continue the line until it crosses the "4 ppm" line

   NOTE: The 4 ppm level is a guide only. You could also use 3 ppm or 5 ppm. However, you should be ready to correct the DO level if it falls below 5-6 ppm. The exact DO level that is harmful to your fish will vary with different conditions.

4. Predict the time when a dissolved oxygen problem might happen and when you should correct the problem

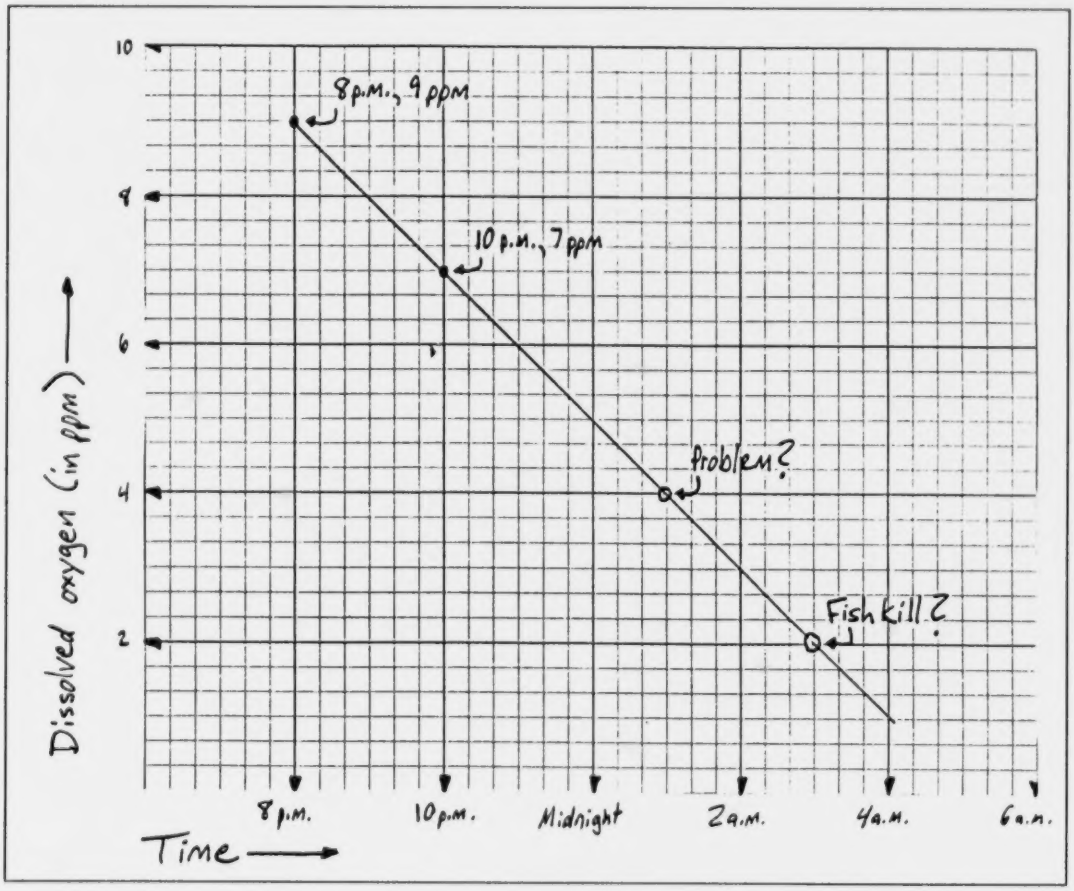
   NOTE: Many factors can influence the dissolved oxygen level in your water at night. Predicting the nighttime DO level is not 100% accurate, because time is the only factor used to predict the DO level. However, by predicting the nighttime DO level, you might be able to identify a pond where a problem could happen.

5. If the DO level decreases 2 or 2 1/2 ppm in one hour, then you should aerate the water immediately and correct the problem in the morning

   NOTE: Water exchange is one of the best methods for correcting or controlling the source of oxygen depletion.

WORKSHEET 3-4 -- Predicting Nighttime Dissolved Oxygen Levels in Ponds

EXAMPLE:



PROBLEMS:

Use the blank graph on the next page.

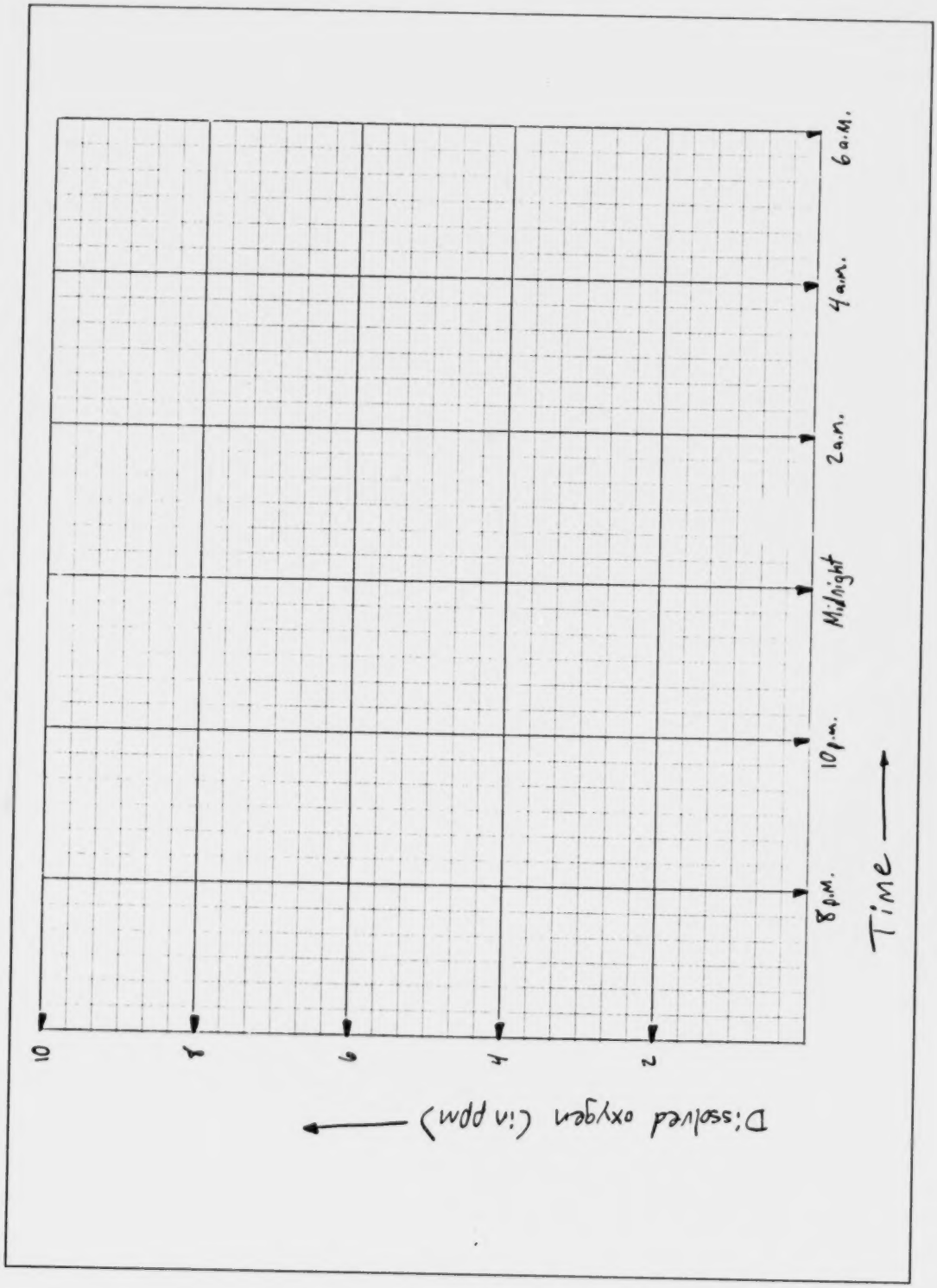
1. If the DO level at 8 p.m. is 8 ppm, and at 10 p.m. is 7 ppm, will the DO level fall below 2 ppm (and risk killing your fish) before 6 a.m.? If yes, when should you correct the problem?

2. If the DO level at 7:30 p.m. is 9 ppm, and at 10 p.m. is 6 ppm, will the DO level fall below 2 ppm before 6 a.m.? If yes, when should you correct the problem?

3. If the DO level at 6 p.m. is 9 ppm, and at 7 p.m. is 7 ppm, when will the DO level reach 2 ppm? When should you correct the problem?

   HINT: Read the instructions to this Worksheet again.

WORKSHEET 3-4 -- Predicting Nighttime Dissolved Oxygen Levels in Ponds



C. Preparing for Stratification and Destratification

Definitions

Stratification -- The separation of pond water into a cold, oxygen-poor bottom layer and a warm, oxygen-rich surface layer

Destratification ("Overturn") -- The mixing of warm and cold pond water layers when the two layers approach the same temperature

NOTE: Overturn is usually not harmful unless it happens with a high biological oxygen demand.

Biological oxygen demand (BOD) -- An unmet demand for oxygen caused when the demand for oxygen in deeper water layers is greater than the oxygen available in those layers

CAUTION: IF THE BIOLOGICAL OXYGEN DEMAND IS HIGH ENOUGH DURING OVERTURN, THE POND WATER COULD TEMPORARILY HAVE NO OXYGEN!

Causes of High BOD

1. Low dissolved oxygen near the pond bottom

   NOTE: The dissolved oxygen level is lowest near the pond bottom because organic decomposition occurs in the deeper, unmixed water, and because the deeper water has no contact with the atmosphere.

2. Poor circulation and oxygenation of bottom water from wind, waves, or photosynthesis

   NOTE: The dissolved oxygen level can drop to zero below 5-6 feet.

3. Accumulated fish waste, feed waste, and other wastes on the pond bottom requiring oxygen in order to decompose

   NOTE: The BOD usually increases throughout the growing season, but is met when the pond water mixes during destratification (overturn).

Periods of Overturn

* When high winds, cold fronts, cold rains, or a combination of these equalize the pond water temperature

  NOTE: Overturn can happen several times each year, due to weather changes.

* In the spring, when the surface water is heated to the same temperature as the warmer bottom water

* In the fall, when the surface water is cooled to the same temperature as the cooler bottom water

CAUTION: BE PREPARED FOR OVERTURN WHENEVER THE WATER TEMPERATURE IS THE SAME THROUGHOUT THE POND. CAREFULLY WATCH FOR LOW DISSOLVED OXYGEN WHEN OVERTURN MIGHT HAPPEN.

D. Controlling Off-Flavor Problems

Definition

Off-Flavor -- Poor flavor in catfish, often caused by blue-green algae and bacteria. The bacteria produce a substance called geosmin which a catfish absorbs like a sponge. The fish then develops a musty odor and flavor.

NOTE: Other sources of off-flavor include poor-quality feeds, low pH (below 4), and polluted or contaminated water.

Off-Flavor Expenses

1. Loss of sales

   NOTE: Fish keep an off-flavor even after they are processed. You can lose customers by selling off-flavor fish, and many buyers (such as processors) will not buy off-flavor fish.

2. Feed expense

   NOTE: You must keep feeding your fish while you correct the off-flavor problem, even though your fish may have already reached market size.

3. Added costs of pumping water (if needed)

4. Time

   NOTE: Clearing-up an off-flavor problem can take a week or longer.

Signs of Off-Flavor

1. Musty odor and flavor

   NOTE: This is the most common off-flavor.

2. Stale flavor

3. Chemical flavor

4. Fecal (fish waste) flavor

Preventing Off-Flavor

1. Keep the quality of water high

   * Avoid overfeeding your fish -- too much feed can become waste material that pollutes the water

   * Control blue-green algae

* Use high-quality feeds that are not stale

* Keep the water clean and free of pollutants such as oil, etc.

NOTE: Drain water off the bottom (do not take the oxygen-rich water near the surface) or circulate fresh water if needed and if you cannot solve the off-flavor problem any other way.

2. Avoid overstocking

3. Test your fish for off-flavor 2 weeks before harvest

   NOTE: You should test for off-flavor before harvesting, in time to correct the problem. Processors also test for off-flavor at the pond and at the processing plant, because catfish can go off-flavor during harvest and during transport.

4. Hold any off-flavor fish in clean water (free of geosmin and other sources) for a week or longer, or until the off-flavor is gone

E. Controlling Weeds

Problems with Weeds

1. Compete with your fish for oxygen at night
2. Interfere with feeding
3. Lower the daytime level of dissolved oxygen by reducing the amount of light entering the water and needed for phytoplankton to grow
4. Lower the water temperature by blocking sunlight
5. Interfere with harvesting
6. Block water draining and intake systems

   EXAMPLE: Clogging screen filters, turndown pipes, etc.
7. Provide cover for predators

Some Causes of Problems with Weeds

* Shallow water (less than 2 feet deep)
* Not enough phytoplankton to prevent the growth of water plants
* Too many nutrients in the water from overfeeding, fertilizing, decaying plant materials, septic tanks, feedlots, etc.
* Poor pond design or adaptation for catfish culture

Types of Weeds

1. **Filamentous Algae ("moss")** -- Free-floating mats (scum) or attached to the pond bottom
2. **Submerged (below the surface)** -- Plants that are attached to the pond bottom but that can reach the surface (See Figure 3-8)
3. **Emergent** -- Plants that are attached to the pond bottom but grow above the surface of the water (See Figure 3-8)

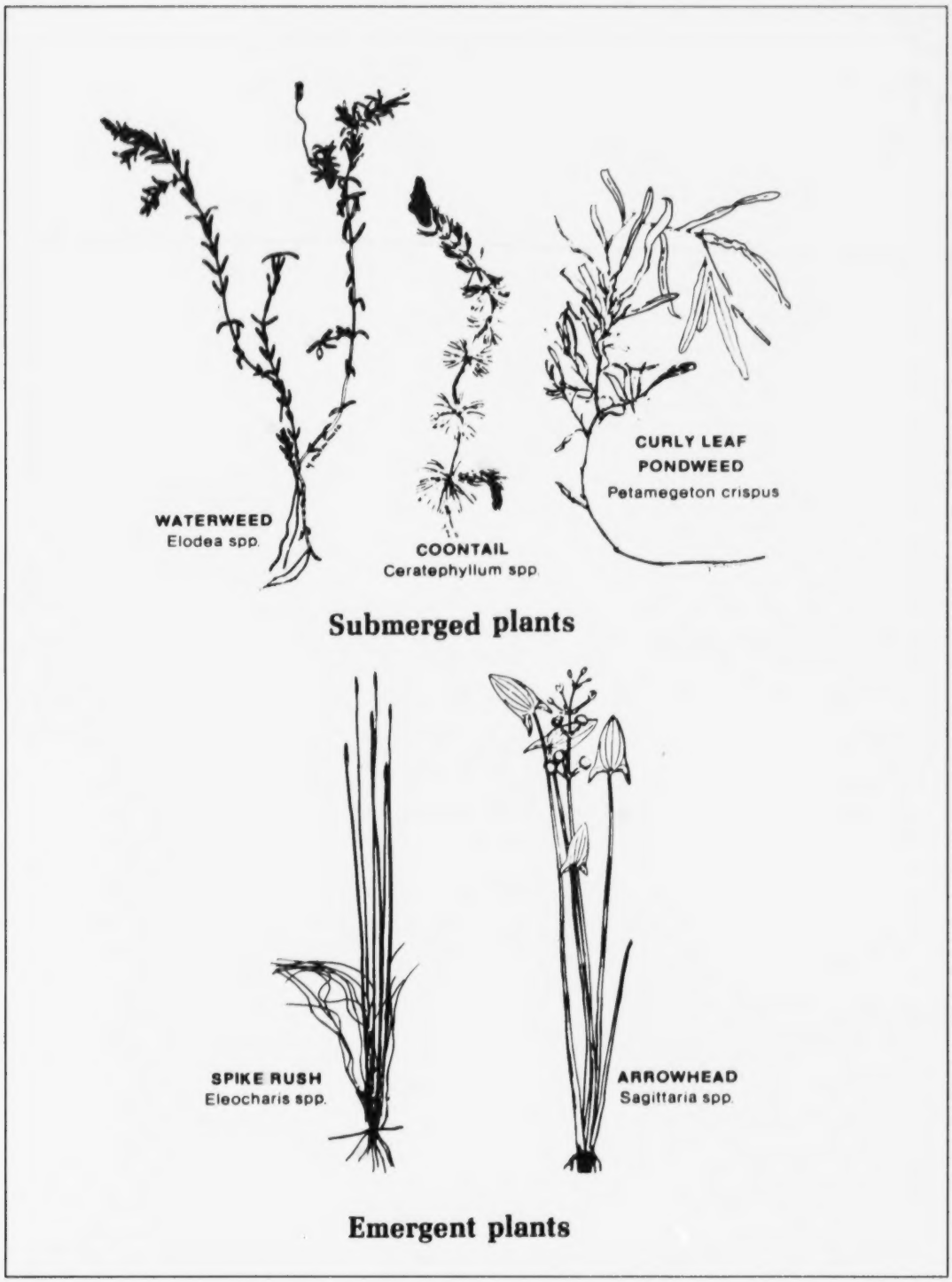


Figure 3-8. Examples of submerged and emergent plants. (Courtesy of Oklahoma Department of Wildlife Conservation.)

133a

4. **Floating Plants** -- Plants that float on the surface of the water

5. **Phytoplankton "Bloom"** -- Growth of phytoplankton

Checking Phytoplankton Density

Using a Secchi Disk -- A flat, weighted disk, 8" across, with alternating black and white quarters and a measured length of chain, yardstick, or rope attached (See Figure 3-9)

1. Lower the Secchi disk into the water until you cannot see the disk

2. Read the handle (or use a ruler) to find the depth

   NOTE: Secchi disk readings should be about 18-24 inches. Lower readings (below 12) show a dense growth of phytoplankton that may create risks with the dissolved oxygen level. <u>If your reading decreases suddenly, watch your water very closely</u>. "Safe" readings may be different for different ponds.

Using Your Arm

1. Lower your arm into the water up to your elbow

2. Look at the palm of your hand -- You should be able to see the palm of your hand. If not, then you may have excessive phytoplankton in your water

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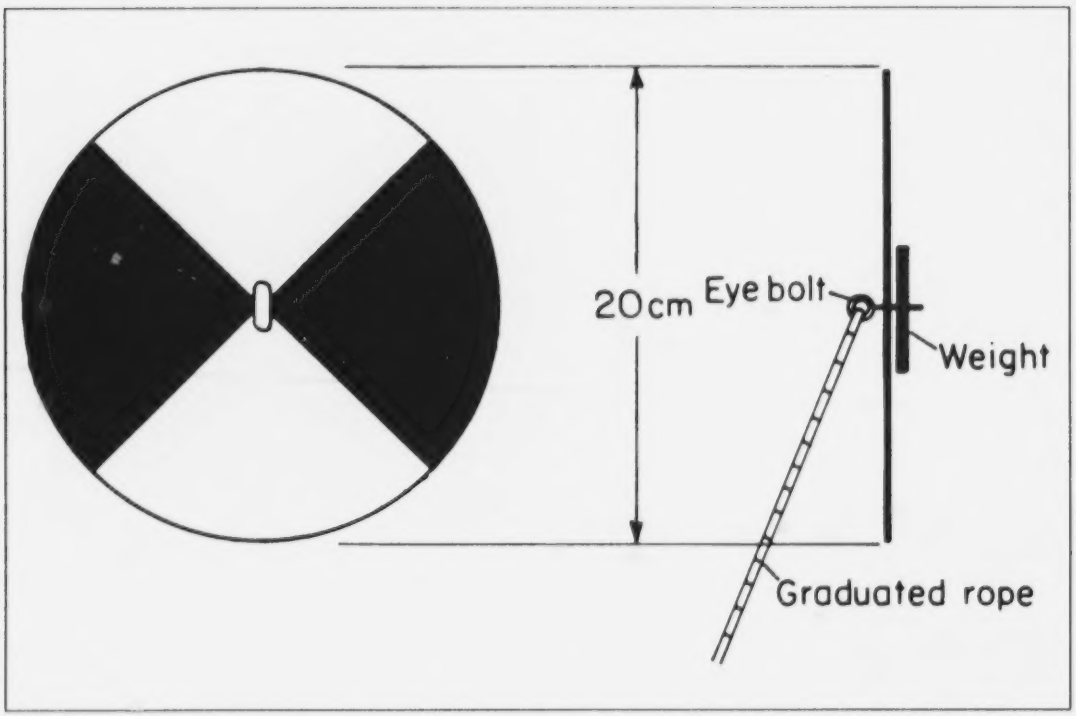


Figure 3-9. A Secchi disk. (Courtesy of Agricultural Experiment Station, Auburn University.)

Methods of Weed Control

1. Mechanical control -- Physically removing the weeds from the water

Advantages

* Practical if you have limited funds or if labor costs are low
* Does not endanger your fish

Disadvantages

* Requires physical labor (labor-intensive)
* Is not 100% effective and does not last long
* Clouds the water and may release toxic substances

2. Biological control -- Stocking plant-eating fish, such as grass carp, in your water to remove weeds

Advantages

* Is efficient

  NOTE: The number of fish needed depends on the need itself. Check with experts.

* May provide food fish or fish for stocking--grass carp are edible

Disadvantages

* May not be legal in all states (grass carp)

* May add nutrients that cause a more serious weed problem

* Compete with catfish for feed

* May dangerously reduce the level of dissolved oxygen in the water

3. Chemical control -- Using herbicides to control the growth of weeds

Advantages

* Are easy to apply

* Require minimum labor

Disadvantages

* Are effective for short lengths of time

* Add decomposed plant materials to the pond, causing heavier growth of plants later and requiring heavier applications of herbicide

* Can contaminate your fish, killing the fish, reducing the growth rate of the fish, or allowing the chemical to be transferred to people

* Apply to specific species of plants, requiring more than one herbicide to control all of the weeds present

  NOTE: You must be able to identify the plants in your water before you use any herbicide!

* Are effective only at certain temperatures

  CAUTION: EFFECTIVE TEMPERATURES MAY VARY WITH SPECIFIC CHEMICALS.

* Are expensive

Controlling Weeds

1. Get expert advice before using any chemical controls

2. Identify the plant species involved

   NOTE: The species may determine your control method, especially with chemical controls.

3. Avoid using chemicals as your first choice

4. Know how the water is used <u>before</u> you control weeds

   NOTE: Do not use herbicides in water used for irrigation.

5. If you use chemicals, use only <u>approved</u> chemicals

Considerations for Chemical Controls

---

* Is the herbicide legal for use with food fish?
* What species of plants are involved?
* How deep is the water?
* What is the application rate for the chemical and what are the factors affecting the application rate?
* How will the chemical change the level of dissolved oxygen?
* How often must the treatment be repeated?
* What types of personal protective equipment are required when using the chemical?

---

3. Managing Water Supplies

Unit Review

1. Match the types of water sources to their advantages and disadvantages.

_____a.	Is your best source of water, if economical	1.	Well water
_____b.	Usually maintains a constant temperature	2.	Spring water
_____c.	Cannot by itself supply your needed volume of water	3.	Stream-fed
_____d.	Is a constant source of disease	4.	Surface run-off
_____e.	Does not have problems with trash fish, pesticides, flooding, etc.		
_____f.	May not need a pumping system		
_____g.	Usually has a low level of dissolved oxygen (DO), requiring aeration to improve DO level		
_____h.	Involves legal restrictions		
_____i.	Has a high flood potential		
_____j.	Is a free source of water		
_____k.	Adds silt to your water		

2. List four (4) requirements of water sources.

a. _____

b. _____

c. _____

d. _____

3. Identify elements of water quality by writing an X in the space beside each of the elements of water quality in the list below.

_____a. Dissolved oxygen

_____b. Off-flavor

_____c. Temperature

_____d. Alkalinity

_____e. Phytoplankton bloom

_____f. pH

_____g. Water purity

_____h. Ammonia

4. List three (3) sources of information about water quality.

a. _____

b. _____

c. _____

5. Define dissolved oxygen.

_____

_____

_____

6. Explain the importance of controlled dissolved oxygen levels by completing each of the sentences below.

a. Fish need _____ _____ to live and grow.

b. Levels below 1-2 ppm will _____ your fish.

c. Levels below 5-6 ppm can reduce the levels of _____ and _____.

d. _____ water plants (such as phytoplankton) and _____ (larger, leafy water plants with roots) affect dissolved oxygen levels.

e. Low DO levels require some kind of _____ to return the water to safe levels.

7. Describe the daytime and nighttime levels of dissolved oxygen. If a statement describes the daytime level of dissolved oxygen, write a D in the space. If a statement describes the nighttime level, write an N.

_____a. Plants use oxygen from the water

_____b. Microscopic water plants produce oxygen during the process of photosynthesis

_____c. The level of dissolved oxygen is higher

_____d. The level of dissolved oxygen in the water decreases

8. Name four (4) problems with low dissolved oxygen.

a. _____

b. _____

c. _____

d. _____

9. Identify basic guidelines for measuring oxygen levels and preventing low dissolved oxygen by writing an X in the space beside each guideline.

_____a. Visually check for signs of low DO levels

_____b. Check the DO level at first light

_____c. Control phytoplankton bloom

_____d. Check the level of dissolved oxygen in at least two places each time in each pond, on the upwind and downwind sides

_____e. Check the level of dissolved oxygen in each pond in one location only

_____f. Predict nighttime periods of low dissolved oxygen

_____g. Be ready to correct any problems with DO levels

_____h. Lower the water temperature by blocking sunlight

_____i. Pump fresh oxygenated water into ponds with low DO levels

_____j. Control macrophytes and rooted plants

_____k. Watch the feeding activity of your fish

_____l. Identify the plant species involved

_____m. Aerate or recirculate the water in emergencies or continually

_____n. Maintain safe water temperatures

_____o. Limit the runoff of manures, excess feed, and plant materials

10. Define stratification, destratification, and biological oxygen demand by writing the number on the right beside the definition on the left.

_____a. The mixing of warm and cold pond water layers when the two layers approach the same temperature

1. Stratification
2. Destratification

_____b. An unmet demand for oxygen caused when the demand for oxygen in deeper water layers is greater than the oxygen available in those layers

3. Biological oxygen demand

_____c. The separation of pond water into a cold, oxygen-poor bottom layer and a warm, oxygen-rich surface layer

11. Identify three (3) causes of high BOD.

a. _____

_____

b. _____

_____

c. _____

_____

12. Identify three (3) periods of overturn.

a. _____

_____

b. _____

_____

c. _____

_____

13. Define <u>off-flavor</u>.

_____

_____

_____

14. Identify off-flavor expenses.

a. _____

b. _____

c. _____

d. _____

15. List signs of off-flavor.

a. _____

b. _____

c. _____

d. _____

16. Identify basic guidelines for preventing off-flavor by writing an X in the space beside each guideline.

_____a. Keep the quality of water high

_____b. Promote the growth of blue-green algae

_____c. Test your fish for off-flavor 2 weeks before harvest

_____d. Hold any off-flavor fish in clean water for a week or longer, or until the off-flavor is gone

_____e. Avoid overstocking

_____f. Avoid understocking

17. Name five (5) problems with weeds.

a. _____

b. _____

c. _____

d. _____

e. _____

18. Distinguish among types of weeds by writing the number on the right that matches the description on the left.

_____a.	Plants that are attached to the pond bottom but that can reach the surface	1.	Filamentous algae
_____b.	Free-floating mats (scum) or attached to the pond bottom	2.	Submerged
		3.	Emergent
_____c.	Plants that are attached to the pond bottom but grow above the surface of the water		

19. Match the methods of weed control to their advantages and disadvantages.

_____a.	Practical if you have limited funds or if labor costs are low	1.	Mechanical control
_____b.	May provide food fish	2.	Biological control
_____c.	May dangerously reduce the level of dissolved oxygen in the water	3.	Chemical control
_____d.	Are easy to apply		
_____e.	Does not endanger your fish		
_____f.	Requires physical labor (labor-intensive)		
_____g.	Are effective only at certain temperatures		
_____h.	Require minimum labor		
_____i.	Is efficient		
_____j.	Compete with catfish for feed		

20. Identify basic guidelines for controlling weeds by writing an X in the space beside each guideline.

_____a. Use chemicals as your first choice

_____b. Get expert advice before using any chemical controls

_____c. Know how the water is used after you control weeds

_____d. Know how the water is used before you control weeds

_____e. Identify the plant species involved

_____f. Choose the control method that meets your needs

_____g. Avoid using chemicals as your first choice

_____h. If you use chemicals, use only approved chemicals

To check your answers, review the unit.

4. Planning Production Facilities

Unit Objectives

After completing this unit, you should be able to

1. Match the types of catfish culture to their advantages and disadvantages
2. List the basics of pond cultures
3. Distinguish between types of ponds
4. Describe features of suitable land sites
5. Identify factors of pond design
6. List types of drainage systems
7. List basic drainage requirements
8. Review land sites for pond culture (WORKSHEET 4-1)
9. Estimate the costs of building pond cultures (WORKSHEET 4-2)
10. Record surface area and volume (WORKSHEET 4-3)
11. List pond requirements for cage culture
12. Identify cage requirements
13. List cage cost factors
14. Identify basic guidelines for the placement of cages
15. Describe feeds for cage culture
16. Identify basic guidelines for stocking cage cultures

4. Planning Production Facilities

A. Comparing Production Facilities

Types of Catfish Culture

1. Pond cultures

Advantages

* Involve generally lower risks
* Can use existing ponds adapted to catfish culture, or custom-designed ponds
* Can use a variety of water supplies
* Require generally less-intensive management practices than cage cultures
* May allow for use of an incomplete catfish feed at low production levels
* Benefit from a pond ecology as a natural system for providing dissolved oxygen, disposing of waste materials, etc.
* May offer a higher profit potential than with cage culture
* Offer a higher volume of production

NOTE: Pond cultures account for most commercial catfish farms.

Disadvantages

* May include higher start-up costs if ponds must be constructed or improved
* Can create problems with trash fish, predators, contamination from runoff, etc.
* Involves less control over limiting factors in the pond ecology
* Are harder to harvest because of the greater area to be harvested, greater amount of equipment needed, access to the pond, rough pond bottoms, and other problems

2. Cage cultures

Advantages

* Can use a variety of existing surface water supplies

* Require a lower starting investment when using existing bodies of water

* Allow for easy monitoring of feeding patterns and health

* Are easier to harvest than other cultures, especially in ponds that are difficult to seine

Disadvantages

* Require deeper ponds (6-10 feet) for water circulation

  NOTE: Ponds over 10 feet deep will have problems. Ponds over 15 feet deep should not be used for catfish culture.

* Require generally more-intensive management practices than pond cultures

* Result in generally lower production per surface acre than pond cultures

* Require moving water for aerating (providing dissolved oxygen) and for disbursing waste

* Can be affected by fouling of mesh material from plant growth

* Require a complete floating feed to supply all nutrients, usually more expensive than other feeds

* Can speed the transmittal of diseases among crowded fish

* Are easier to steal from than pond cultures

3. Vat and Raceway cultures

Advantages

* Need a limited amount of space, depending on the number and size of vats

* Can be built almost anywhere

* Allow for easy observing, feeding, and harvesting

* Collect fish wastes for other uses

* Raceways serve as good holding facilities, can correct off-flavor problems, and provide moving water having a high level of dissolved oxygen

Disadvantages

* Are sophisticated and extremely risky, and are still largely experimental in Oklahoma

* Create problems with waste recirculation and filtration

* Require a pumping system and back-up

* Require a constant source of power, including backup sources in case of power failure

  CAUTION: IF THE POWER FAILS WITHOUT A BACK-UP, YOUR CULTURES WILL HAVE NO SOURCE OF AERATION AND DISSOLVED OXYGEN. ALL OF YOUR CATFISH WILL QUICKLY DIE.

* Raceways may have high startup costs

* Raceways require a high density of fish for profit

* Raceways need a constant source of fresh, clean water

As a first-season catfish farmer, you will probably start out with a pond culture by adapting an existing pond, building a small pond, or using a cage culture

Pond cultures and cage cultures usually have lower startup costs and lower risks. Therefore, vat and raceway facilities are not covered in more detail in this Workbook

B. Planning for Pond Culture

Basics of Pond Cultures

1. Water source -- Of high quality and needed quantity
2. Drainage system
3. Holding area (pond) -- Holds water between the water source and the drain
4. Good soil and ground features -- Suitable for catfish culture
5. Access -- To and from the pond

Types of Ponds

1. Watershed pond
   * Uses the natural characteristics of the land site
   * Can use runoff water, supplemented by pumped water

   NOTE: It is risky to rely completely on runoff water as the source of water for your ponds.

2. Levee pond
   * Cut and filled
   * Built with levees on all sides, often using a system of adjacent ponds sharing a levee
   * Has a gentle slope
   * Filled from wells or by pumping

Comparing Pond Sizes

Large Ponds (1-3 acres or more)

* Use more of the land site for production, instead of for access
* Cost less per acre to build
* Require more water from your water source (may require more water than you are legally allowed to use) to fill the pond and keep it filled
* Take longer for water temperatures to change than in small ponds

Small Ponds (Less than 1 acre)

* Meet the needs of small-scale operations
* Generally involve less risk -- management problems are on a smaller scale although the types of management problems can be the same for all ponds
* Have less "buffer" capacity and show evidence of problems faster than large ponds
* Can be managed using less equipment and labor
* Tend to be overstocked

Features of Suitable Land Sites

NOTE: Suitable <u>existing</u> features of your land site can save you money when you build or improve a pond for catfish culture.

1. Soil

   * Suitable for pond bottom and dam or embankment

   * High water-holding ability extending several feet below the pond bottom (to resist leaking)

     NOTE: Clay or clayloam soils are best. Lower-quality soils could be sealed at different levels of expense. However, pond liners are expensive.

   * Free of contamination from chemical run-off or from excess cattle wastes

Examples of Bad Soil and Ground Features

* Sandy soil
* Gravel
* Limestone or other "layered" rock -- Cracks in rock layers can cause problems with water seepage
* Cavernous ("cave-like") underground areas -- Underground air pockets can allow water to seep through the bottom of your pond
* Swampy areas -- Swampland or swamp-like areas are expensive to drain, dredge, and adapt for catfish culture. Swampy areas may also be subject to flooding

2. Layout (before building or improving)

   * Gentle slope toward a drainage area

     NOTE: A greater slope requires a higher levee, which will add to your cost of building or improving a pond.

   * Allow for gravity filling and draining (by gently sloping toward a drainage area

     NOTE: An existing site having a gentle slope toward a drainage area can result in a less expensive cut-and-fill construction.

   * Located with the prevailing wind across the pond

3. Flood potential -- limited flood potential

Factors of Pond Design

NOTE: Contact the Soil Conservation Service for help in surveying your pond site and setting pond stakes.

1. Levees -- Sloping inside embankments with about a 3:1 slope (3 feet wide for every 1 foot high)

   NOTE: Levees with about a 3:1 slope make seining easier. Inside embankments that are less steep will allow the water to be shallower along the shoreline, which promotes the growth of weeds and attracts water birds.

2. Ground features (pond bottom)

   * Flat and smooth

     NOTE: A flat, smooth pond bottom will help prevent your seine from catching and tearing on any obstructions.

   * Rectangular (if possible)

     NOTE: A rectangular pond will allow you to harvest with a shorter seine.

   * Gently sloping toward a drainage system

   * Clear of obstructions

     EXAMPLE: Trees, brush, stumps, logs, trash, etc.

3. Depth -- At least 3-5 feet deep (6-10 feet for cage cultures)

   NOTE: Deeper ponds (deeper than 6 feet) can cause problems with pond cultures.

4. Drainage system

   * To flush water through the pond

   * To control overflow

   * To make harvesting easier by controlling the water level

   * To dry and revitalize the pond

   * To repair the pond

5. Access (during all weather conditions)

   * For harvesting -- Roads/tracks to and around ponds for harvesting vehicles and equipment, from a main road

     NOTE: Harvest times are often during periods of rainy weather. Be sure that roads and tracks are passable for heavy vehicles during poor weather conditions.

   * For aerating -- Paddlewheel or tractor-powered aerators, etc., that must be brought to the pond and operated from the shore

* For feeding -- Access for feed trucks, tractors and feed wagons, etc.

* For marketing -- Pond bank sales, etc.

* For maintenance -- Draining, treating the soil, removing sediment, etc.

6. Harvestability

* For seining

* For draining

NOTE: You must consider your method of harvesting as you design and construct a pond. Your methods of harvesting also influence your consideration of ground features, drainage systems, and access.

7. Protection (vegetation or rock cover)

* To hold sediment and help prevent erosion of embankments

* To control predators

NOTE: Be sure that any vegetation or rock cover used as protection will not interfere with harvesting.

8. Water supply system -- To carry water from its source to your pond(s)

* Accessible for repairs

* Freeze-proof

* In compliance with all regulations and permit requirements

NOTE: Use a system of underground pipe, if possible.

9. Safety

* For yourself and other workers

* For customers of pond bank or fee-fishing operations

* For anyone who must be near the pond at any time

NOTE: You must also comply with laws and regulations for dam safety and pond construction.

Types of Drainage Systems

1. Pipe system

   * Requires a flat landsite

2. Ditch system

   * Uses more land than a pipe system (disadvantage)

   * Offers better water quality by removing solids

Basic Drainage Requirements

1. Must use pipes that are large enough to drain the pond in a reasonable time and consistent with guidelines from the Oklahoma Water Resources Board and others

2. Must use a valve, turndown pipe, or other method for controlling the water depth

3. Must be freeze-proof

   NOTE: Bury external valves and let some water flow during the winter.

WORKSHEET 4-1 -- Reviewing Land Sites for Pond Culture

Instructions

1. Consider your existing or planned sites available for catfish culture

2. Answer the questions on this Worksheet and use your answers to help plan your production facilities

   NOTE: Collect information about the features of land sites for pond culture from experienced catfish farmers, Soil Conservation Service, state experts, and written materials.

3. Contact the Soil Conservation Service for help in surveying your pond site and setting pond stakes

   NOTE: Sites that are not suitable for pond culture may be suitable for cage culture.

WORKSHEET 4-1 -- Reviewing Land Sites for Pond Culture

FEATURES OF SUITABLE LAND SITES

NOTE: This list may not be complete.

Soil

1. Test the soil in your existing ponds or at different locations on your land site. First, shape a handful of soil into a ball, then put the ball into a jar of water.

   NOTE: Use this simple test to get an idea about the water-holding ability of your soil. Do not judge your land site on the basis of this test only!

   Describe the water-holding ability of the soil. Test in as many different locations as needed to get a good "picture" of your soil:

	Location 1	Location 2	Location 3	Location 4
Very good	_____	_____	_____	_____
Good	_____	_____	_____	_____
Not good	_____	_____	_____	_____

2. Talk to experts and experienced catfish farmers. Do they think that your soil is suitable for pond culture? Explain why or why not.

_____

_____

_____

3. Contact the Soil Conservation Service for a bore test of your land site. What does the bore test tell you about your soil for pond culture?

_____

_____

_____

4. Could existing or planned sites be contaminated from chemical run-off or cattle wastes?

   NOTE: Contamination could come from someone else's land site.

   _____Yes _____No

5. Can you afford to eliminate any sources of chemical contamination?

_____Yes _____No

6. Can you afford to consider restricting the use of existing or planned ponds for catfish culture only?

Layout (before building or improving)

1. Do existing or planned sites slope gently toward a drainage area? (This slope can allow for gravity filling and draining of the pond, which can reduce your costs of construction.)

_____Yes _____No

2. Do existing ponds have a drain and a drainage system?

_____Yes _____No

Flood potential

1. At what time(s) of the year do existing or planned sites flood?

_____

2. What is the highest possible flood level at all sites considered for pond culture?

_____

3. How can you limit the flood potential of all existing or planned sites?

_____

_____

FACTORS OF POND DESIGN

NOTE: This list may not be complete.

Water supply system

1. List the possible sources of high-quality water available for catfish culture. (See Unit 3.)

_____

2. Do you have the required permits for using and discharging the water?

_____Yes _____No

WORKSHEET 4-1 -- Reviewing Land Sites for Pond Culture

If NO, contact the Oklahoma Water Resources Board about the rights to water sources. (See Unit 3.)

3. How much water can the watershed supply? Contact the Soil Conservation Service for maps, topography sheets, and other watershed information.

_____

4. What is the travel distance from your water source to your pond sites? (Check the distance from the water source to each existing pond or planned pond site.)

_____

5. Could the water source be dammed for a pond culture?

_____Yes _____No

If YES, contact the Oklahoma Water Resources Board about the rights to water sources. (See Unit 3.)

6. Do you have a water supply system for existing ponds?

_____Yes _____No

If NO, can you install a system for any site considered for pond culture?

_____Yes _____No

Drainage system

1. Do existing ponds have a drain and drainage system?

_____Yes _____No

If NO, can you install a drain and drainage system?

_____Yes _____No

2. Can you drain <u>and</u> refill existing ponds?

3. Are existing drainage systems freeze-proof?

4. Describe the current and possible uses of any existing drainage systems:

	Current Use	Possible Use	Not Possible
(a) To flush water through the pond	_____	_____	_____
(b) To control overflow	_____	_____	_____
(c) To control the water level	_____	_____	_____
(d) To dry/drain the pond	_____	_____	_____

WORKSHEET 4-1 -- Reviewing Land Sites for Pond Culture

Ground Features (pond bottom)

1. Are existing or planned sites flat, smooth, and clear of obstructions?

   _____Yes _____No

   If NO, can you improve the sites? Consider any possible problems with clearing the site.

   _____Yes _____No

Depth

1. Are existing or planned sites deep enough for pond culture excluding mud and sediment (water at least 3-5 feet deep at its lowest level during the growing season)?

   _____Yes _____No

2. If existing sites have problems with mud and sediment, can you drain and renovate existing ponds for pond culture?

   _____Yes _____No

3. Could planned sites have problems with mud and sediment?

   _____Yes _____No

   If YES, how will you improve the site?

   _____

   _____

Access (during all weather conditions)

1. Are existing or planned sites surrounded by a road or track on all sides?

   _____Yes _____No

2. Are existing or planned sites accessible for harvesting vehicles and equipment from a main road?

   _____Yes _____No

WORKSHEET 4-1 -- Reviewing Land Sites for Pond Culture

3. Are existing or planned sites accessible

for aerating? _____Yes _____No

for feeding? _____Yes _____No

for marketing? _____Yes _____No

for maintenance? _____Yes _____No

If NO, can the site be made accessible?

_____Yes _____No

Protection

1. Are existing ponds protected by vegetation or rock cover?

_____Yes _____No

2. How would planned sites be protected?

_____

_____

Levees

1. Do existing ponds have sloping inside embankments with about a 3:1 slope?

_____Yes _____No

If NO, can you improve the existing levees?

_____Yes _____No

Safety

1. Do existing or planned sites have any unsafe conditions?

_____Yes _____No

If YES, how can you correct each unsafe condition?

_____

_____

WORKSHEET 4-1 -- Reviewing Land Sites for Pond Culture

MANAGEMENT FACTORS

NOTE: This list may not be complete.

1. Can you manage existing or planned sites for pond culture <u>every day</u> with the labor available to you?

   _____Yes _____No

2. Are existing or planned sites <u>observable</u> to guard against the theft of your fish?

   _____Yes _____No

   If NO, how can you improve the site for better observation?

   _____

   _____

WORKSHEET 4-2 -- Estimating the Costs of Building Pond Cultures

Instructions

1. Get estimates about the costs of improving existing sites or building new sites for pond culture

   NOTE: Contact construction companies, pond construction companies, heavy equipment operators, other catfish farmers, and other qualified sources for information and estimates. You may be able to improve or build a pond culture yourself.

2. Contact your local Soil Conservation Service office for advice before construction

3. Consider your identified markets and the level of production needed for each market

   NOTE: Always consider your markets when planning your production facilities.

4. Review your answers from Worksheet 4-1

5. Plan your production facilities, based on your estimates, your markets, and your site review

   NOTE: You might decide to (a) improve existing ponds, (b) build new ponds, or (c) choose cage culture.

WORKSHEET 4-2 -- Estimating the Costs of Building Pond Cultures

GENERAL PRE-CONSTRUCTION QUESTIONS

NOTE: This list may not be complete.

		Yes	No
1.	Does the soil have a high water-holding ability extending several feet below the surface, and is it leak-resistant (seepage-resistant)?	_____	_____
	If NO, can you use a different (acceptable) land site?	_____	_____
	OR		
	Can you afford to bring in enough clay from another site to cover the pond bottom and build the pond sides (embankments)?	_____	_____
2.	How many ponds do you need to meet the demands of your identified markets? Give the number of ponds and the size of each pond, in acres.		
	NOTE: You should have identified your possible markets in Unit 2.		
	_____		
	_____		
3.	Is the land site large enough for the number and size of ponds needed (is acreage available)?	_____	_____
	If NO, would you consider limiting your markets to equal the production capability of your existing ponds?	_____	_____
4.	Could wind erode down-wind banks?	_____	_____
5.	Does the land site <u>easily</u> lend itself to drainage and construction?	_____	_____
	NOTE: Land sites that cannot be easily drained or built will cost more to construct.		
6.	Have you made a written plan for your ponds?	_____	_____
7.	Have you contacted your District Conservationist about laws and regulations for dam safety?	_____	_____

WORKSHEET 4-2 -- Estimating the Costs of Building Pond Cultures

COST ESTIMATES
(cubic yard costs)

Construction Requirements	Cost
	$
TOTAL ESTIMATED COST	$

WORKSHEET 4-3 -- Recording Surface Area and Volume

Instructions

1. Calculate the surface area and volume of your existing or planned pond sites at different depth stages

   NOTE: Contact the Soil Conservation Service for help. You can record this information at the time that you are surveying your pond sites and setting pond stakes.

2. Record the surface area and volume of each pond at different depth stages on the "Surface Area and Volume Record"

   NOTE: Keep this Record as a part of your permanent recordkeeping system. Surface area and volume information is important for calculating disease and parasite treatments. A good time to record this information is before your pond sites are filled.

Steps

STEP 1 Identify depth stages in each existing or planned pond

STEP 2 Calculate the surface acreage of each pond at each identified depth stage

STEP 3 Find the average depth (in feet) for each pond at each identified depth stage

STEP 4 Calculate the volume of each pond at each identified depth stage

EXAMPLE: At a marked depth stage of 7 feet, Pond "A" covers 3 surface acres and has an average depth of 6.5 feet. The volume of Pond "A" at the depth stage of 7 feet is : 3 surface acres X 6.5 feet = 19.5 acre-feet of water.

WORKSHEET 4-3 -- Recording Surface Area and Volume

SURFACE AREA AND VOLUME RECORD
(Copy for each pond)

Pond Number_____

Production Season:_____to_____19_____

Depth Stage	Surface Acreage	Average Depth (in feet)	Volume (in acre-feet)

C. Planning for Cage Culture

Pond Requirements

1. High-quality water

   NOTE: See Unit 3, "Managing Water Supplies," for the elements of water quality.

2. Deep water -- 6-10 feet deep at the pond's lowest water level during the season and allowing for space below the cage

   CAUTION: IN CAGE CATFISH CULTURE, SHALLOW WATER USUALLY INVOLVES MORE RISK THAN DEEP WATER.

Cage Requirements

1. Made from durable, non-toxic, and rustproof or waterproof materials

   EXAMPLE: Frames can be made from aluminum; PVC plastic pipe; rust-proofed steel; cedar, redwood, or treated and rot-resistant wood; or other material that will not easily decay in water. Netting can be plastic, plastic-coated wire, or coated nylon net. (However, turtles and muskrats can tear through plastic and nylon.)

   CAUTION: LEACH ANY TREATED AND ROT-RESISTANT WOOD BEFORE PUTTING THE WOOD IN YOUR PONDS.

2. Allow maximum water circulation without allowing fish to escape

   NOTE: A common size mesh is 1/2 inch X 1 inch.

3. Float on the surface (or be suspended at the surface)

   EXAMPLE: Use styrofoam blocks, plastic jugs, sealed PVC pipe, or other floating objects that will not waterlog.

4. Hold a volume of at least 1.3 to 2.0 cubic yards (1.0 to 1.5 cubic meters)

   NOTE: A cylindrical cage four feet deep and four feet across is a convenient size for home use or for beginning cage cultures. Commercial-size cages can be rectangular with dimensions four feet by eight feet by four feet.

5. Allow for feeding through a covered feeding hole or through larger mesh at the top of the cage

   NOTE: The covered feeding hole or larger mesh should still prevent fish from escaping and prevent access by predators.

6. Prevent floating feed from being washed out of the cage

   EXAMPLE: Attach a feeding screen of smaller mesh and about 12 inches wide along the inside top of each cage.

Cage Cost Factors

1. Method of supply

   * Home-built

   * Bought from equipment suppliers

2. Number of cages needed

3. Type of design (for most efficient use of materials)

   * Box shape

   * Cylinder shape

4. Cage materials (quality vs. cost)

   EXAMPLE: Experiments at Langston University (Oklahoma) suggest that 1/2 X 1/2 inch "vexar" and the 1/2 X 1 inch plastic-coated wire are the most suitable for caged fish culture. (NOTE: Vexar may require hardware cloth or coated wire to protect it from beavers and muskrats.) Plastic-coated wire mesh usually costs about forty percent (40%) more than "vexar" plastic mesh, but plastic-coated mesh can last 10-15 years, compared to a life span of about 5-10 years for the plastic mesh.

Placement of Cages

1. In deep water 6-10 feet deep at the pond's lowest water level during the season

   NOTE: Deep water will help to keep your cages away from wastes near the pond bottom.

2. At least 2-3 feet above the pond bottom

3. In areas that take advantage of the prevailing wind (except where wave action could be damaging)

   NOTE: Waves created by the wind will increase the amount of water that is exposed to the air, which has a positive effect on the dissolved oxygen level. Waves can also help disperse waste material in the water.

4. Separated from other cages

   NOTE: Space between cages will help improve water circulation and waste removal. To help keep the water circulating freely through your cages, you must clean the outside of each cage to remove algae and other blockages (weeds, trash, etc.). Check on using grass carp or an anti-fouling paint to treat the cage material. Cleaning the cages by hand will stress your fish.

5. Cabled or otherwise suspended above deep water

   NOTE: You could suspend your cages from a single cable across your pond.

Feeds for Cage Culture

1. Floating -- Feed must float so that it will not sink through the cage and out of reach of your fish

   NOTE: Floating feed usually costs more than other feeds, but allows you to watch your fish.

2. Nutritionally-complete -- Fish in cages cannot supplement their diet with other sources of food that are available to fish in ponds

   NOTE: Feeds for cage culture are usually higher in protein (36%) than feeds for pond culture (32%). Feeds that are high in protein are important for growing market-size catfish in one growing season, which is usually the goal of cage culture farmers.

Stocking Cage Cultures

1. Start out on a small scale until you have more experience with cage cultures and are familiar with your ponds

   CAUTION: HIGHER PRODUCTION LEVELS INCLUDE HIGHER RISKS, INCLUDING STRESSING THE FISH AND INCREASING THE CHANCES OF A FISH DIE-OFF.

2. Stock only high-quality fingerlings

   NOTE: Crowding in cages can speed the transmittal of diseases. Always start out with high-quality fingerlings. Reject any fingerlings that show signs of poor quality, including signs of disease or parasites.

3. Stock about 300-350 catfish per cubic meter of cage or about 9-10 per cubic foot

   NOTE: Lower stocking rates (below 100 per cubic meter) increase the risk of fighting among fish. Higher rates increase the chances of a fish die-off from oxygen depletion and from overcrowding.

4. Keep stocking rates below about 1200-2000 catfish per acre

   NOTE: Stocking rates depend on the size of the fish being stocked and on the water quality. Very small ponds might only accept 1000 fish per acre.

   CAUTION: DO NOT USE CAGE CULTURE IN PONDS LESS THAN 1 SURFACE ACRE.

Higher stocking densities could increase the total number and pounds of catfish produced, but may not increase your total number of harvestable fish. You might produce more fish, but each fish will weigh less than it would weigh if grown in a lower-density cage culture

4. Planning Production Facilities

Unit Review

1. Match the types of catfish culture to their advantages and disadvantages.

_____a.	Involve generally lower risks	1.	Pond cultures
_____b.	Require generally more-intensive management practices than pond cultures	2.	Cage cultures
_____c.	Allow for easy monitoring of feeding patterns and health	3.	Vat and Race-way cultures
_____d.	Offer a higher volume of production		
_____e.	May allow for use of an incomplete catfish feed at low production levels		
_____f.	Can use a variety of existing surface water supplies		
_____g.	Involve less control over limiting factors in the pond ecology		
_____h.	Require a complete floating feed to supply all nutrients, usually more expensive than other feeds		
_____i.	Are sophisticated and extremely risky, and are still largely experimental in Oklahoma		

2. List the basics of pond cultures.

a. _____

b. _____

c. _____

d. _____

e. _____

3. Distinguish between types of ponds by writing the number on the right that matches the description on the left.

_____a.	Cut and filled	1.	Watershed pond
_____b.	Uses the natural characteristics of the land site	2.	Levee pond
_____c.	Can use run-off water, supplemented by pumped water		
_____d.	Filled from wells or by pumping		
_____e.	Built with levees on all sides, often using a system of adjacent ponds sharing a levee		
_____f.	Has a gentle slope		

4. Describe three (3) features of suitable land sites.

a. Soil -- _____

_____

_____

b. Layout -- _____

_____

_____

c. Flood potential -- _____

5. Identify factors of pond design by writing an X in the space beside each of the factors of pond design in the list below.

_____a. Levees

_____b. Off-flavor

_____c. Ground features (pond bottom)

_____d. Depth

_____e. Cage materials

_____f. Drainage system

_____g. Placement of cages

_____h. Access

_____i. Protection (vegetation or rock cover)

_____j. Dissolved oxygen

_____k. Water supply system

_____l. Safety

_____m. Harvestability

6. List two (2) types of drainage systems.

a. _____

b. _____

7. List three (3) basic drainage requirements.

a. _____

_____

_____

b. _____

_____

_____

c. _____

_____

_____

8. List two (2) pond requirements for cage culture.

a. _____

b. _____

9. Identify six (6) cage requirements by writing an X in the space beside each cage requirement.

_____a. Made from durable, non-toxic, and rustproof or waterproof materials

_____b. Allow maximum water circulation without allowing fish to escape

_____c. High-quality water

_____d. Allow for gravity filling and draining

_____e. Float on the surface (or be suspended at the surface)

_____f. Hold a volume of at least 1.3 to 2.0 cubic yards (1.0 to 1.5 cubic meters)

_____g. Allow for feeding through a covered feeding hole or through larger mesh at the top of the cage

_____h. Nutritionally-complete

_____i. Prevent floating feed from being washed out of the cage

10. List cage cost factors.

a. _____

b. _____

c. _____

d. _____

11. Identify basic guidelines for the placement of cages by writing an X in the space beside each guideline.

_____a. In deep water 6-10 feet deep at the pond's lowest water level during the season

_____b. On the pond bottom

_____c. At least 2-3 feet above the pond bottom

_____d. In areas that take advantage of the prevailing wind (except where wave action could be damaging)

_____e. Attached to other cages

_____f. Separated from other cages

_____g. Cabled or otherwise suspended above deep water

_____h. Cabled or otherwise suspended above shallow water

12. Describe feeds for cage culture by completing each of the statements below.

a. Feed must _____ so that it will not sink through the _____ and out of reach of your fish.

b. Fish in _____ cannot supplement their diet with other sources of food that are available to fish in _____.

13. Identify basic guidelines for stocking cage cultures by writing an X in the space beside each guideline.

_____a. Start out on a small scale until you have more experience with cage cultures and are familiar with your ponds

_____b. Stock fingerlings of different qualities

_____c. Stock only high-quality fingerlings

_____d. Stock about 300-350 catfish per cubic meter of cage or about 9-10 per cubic foot

_____e. Keep stocking rates below about 3000-4500 catfish per acre

_____f. Keep stocking rates below about 1200-2000 catfish per acre

To check your answers, review the unit.

5. Growing Food Fish

Unit Objectives

After completing this unit, you should be able to

1. Match stocking sizes of fingerlings to their possible harvest sizes in one full season
2. Describe stocking rates in ponds and cages
3. Describe stocking periods
4. List signs of high-quality fingerlings
5. Discuss growth factors
6. Identify guidelines for stocking
7. List basic feed requirements
8. Identify amounts to feed
9. Define feed conversion efficiency (FCE)
10. List the uses of FCE
11. Identify factors influencing FCE's
12. Identify causes of changes in feeding activity
13. Describe methods of feeding
14. Identify basic guidelines for feeding
15. Identify possible feeds for catfish culture (WORKSHEET 5-1)
16. Record feed totals (WORKSHEET 5-2)
17. Identify basic guidelines for handling
18. Define overwintering
19. State reasons for winter feeding
20. Identify guidelines for winter feeding

5. Growing Food Fish

A. Stocking Your Fish in Ponds and Cages

Stocking Sizes

NOTE: These stocking sizes apply to a 180-day growing season in Oklahoma with water temperatures of 70 degrees Fahrenheit or above.

1. 4"-6" fingerlings can produce 3/4 to 1 pound fish in one full season

   NOTE: A 3/4 to 1 pound catfish is barely large enough for sale to most markets.

2. 6"-8" fingerlings can produce 1 to 1 1/2 pound fish in one full season

   NOTE: 6"-8" fingerlings are preferred in Oklahoma to produce a market-size catfish in one season.

3. 8"-10" fingerlings can produce 1 1/2 to 3 pound fish in one full season

   CAUTION: DO NOT STOCK 2-YEAR-OLD FISH IN CAGES. CATFISH LARGER THAN 10 INCHES ARE APPROACHING SEXUAL MATURITY AND CAN CAUSE PROBLEMS IN CAGES.

Stocking Rates

1. In ponds -- About 1200-2000 fish per acre

   NOTE: Consider the carrying capacity of the pond when stocking.

2. In cages -- About 300-350 fish per cubic meter or about 9-10 fish per cubic foot of cage, but not more than 1200-2000 per acre

   NOTE: Lower stocking rates in cages (below about 100 per cubic meter) will increase the risk of fighting among fish. Higher rates (above 1000 fish per acre) increase the chances of a fish die-off and require aeration.

Higher production levels include higher risks, such as disturbing the pond's ecological balance, and increase the chances of a fish die-off. Start out on a small scale until you have more experience.

Stocking Periods

About mid-March to late-April (in Oklahoma), when the water temperature reaches 60-68 degrees Fahrenheit (depending on the weather)

NOTE: The stocking period is generally later with cage cultures, when the pond water is warmer.

Signs of High-Quality Fingerlings

1. From a reputable and recommended supplier

   NOTE: Ask other farmers for advice about choosing a supplier with a good reputation.

2. Free of diseases or parasites

   NOTE: See Unit 6, "Controlling Catfish Diseases and Parasites," for information about the signs of diseases and parasites.

3. Healthy in appearance -- Plump, not skinny, and without frayed fins, lesions, or other signs of disease or poor health

---

Signs of Poor Quality Fingerlings

---

* Bony-headed, with thin, sunken eyes
* Sore spots
* Bulging eyes
* Strange swimming patterns
* Redness around the mouth, vent or fin bases
* Swollen abdomen
* Small white spots
* Dull color (instead of shiny)
* Frayed fins, tail
* Signs of disease

---

4. Appropriate and even size

   NOTE: Four- to six-inch fingerlings can reach a sub-marketable size (3/4 to 1 pound) in one full Oklahoma growing season. Ask for the length you want. Do not settle for whatever length is available.

5. Free of wild fish

Growth Factors

1. Size of fingerlings -- Fingerlings should be about the same size (1 inch larger or smaller is acceptable)

   NOTE: Be sure that the fingerlings you stock are roughly the same size. Larger fingerlings compete with smaller fingerlings for food, and can inhibit the growth of the smaller fish.

2. Stocking rate -- Higher stocking densities could increase the total number and pounds of catfish produced, but may not increase your total number of harvestable fish. The more fish you stock, the less space and oxygen are available to individual fish to grow, and the more your fish must compete with each other for resources

   NOTE: You might produce more fish, but each fish will weigh less than it would weigh if grown in a lower-density culture (especially true in cages).

3. Water temperature -- Water temperature controls the rate of digestion of fish. Most fish reduce or stop feeding when the water temperature is above 86 or 90 degrees Fahrenheit or below 60 or 65 degrees Fahrenheit

4. Dissolved oxygen -- Levels below 4 parts per million (ppm) can reduce feeding and growth

   NOTE: You should be ready to take corrective action if the DO level goes below 4 ppm.

5. Water quality -- Poor water quality can affect the health and growth of fish

   NOTE: See Unit 3, "Managing Water Supplies," for more information about the elements of water quality and their importance.

Guidelines for Stocking

1. Start out on a small scale, until you have more experience

2. Choose only high-quality fingerlings that are the appropriate size

   NOTE: Reject any poor-quality fingerlings.

3. Do not overcrowd your fish

NOTE: Build more cages, instead of overcrowding your fish. Stocking densities that are too high will affect the health and growth of your fish.

4. Avoid transporting fingerlings yourself

NOTE: Suppliers should know how to transport fingerlings with the least amount of stress.

5. Get your fingerlings on feed when stocking

B. Feeding Your Fish in Ponds and Cages

Basic Feed Requirements

1. Nutritionally-complete

   NOTE: A nutritionally-complete feed is especially important for catfish in cage cultures. Fish in cages cannot supplement their diet with other sources of food available to fish in pond cultures.

2. High in protein -- Feeds that are high in protein are important for producing harvestable-size catfish in one growing season

   The higher the protein percentage, the higher the cost. Nutritionally-complete feeds with 32% or 36% protein work well in Oklahoma and may offer the best return on investment

3. Floating -- Sinking pellets are less expensive, but do not work in cage cultures because the pellets sink through the bottom of the cage

   NOTE: In the winter, pond fish need sinking feed. They will not respond well to floating feed.

Advantages and Disadvantages of Floating Feeds

Advantages

* Work well for pond and cage cultures
* Allow you to watch your fish feeding, so you can adjust the amount you feed depending on the amount eaten
* Make your fish come up to feed, so you can observe them for size and any signs of disease or parasites

Disadvantages

* Allow predators to attack fish while feeding
* Are not eaten well by fish when the water temperature goes down (below 50 degrees Fahrenheit)

4. Right size for different size fish

   * Small, 1/8-inch floating pellets for small fingerlings (4 inches or smaller)

   * Pellets about 3/8-inches in diameter for larger fingerlings and adult fish (8 inches or larger)

   NOTE: Choose the size feed that is the right size for the smallest fish in the pond or cage.

Amounts to Feed

During one Oklahoma growing season (not including winter feeding), you should feed your fish

1. All of the feed that your fish will eat in 20-30 minutes

2. About 2-3% of the weight of the fish in each pond or cage each day (4-5% for fingerlings when first stocked), if the water temperature is between about 65-86 degrees Fahrenheit

   NOTE: Reduce the feeding rate or stop feeding when the water temperature is outside of the 65-86 degree range. Carefully watch the water temperature and adjust the feeding rate as needed -- "let your fish decide".

3. Not more than 25-35 pounds per surface acre per day, unless aeration is available (depending on the pond)

   NOTE: More than 25-35 pounds of feed for each surface acre each day could cause problems with water quality. If you must use more feed, aerate the water and check the dissolved oxygen level often.

Feed Conversion Efficiency

Definition -- The feed conversion efficiency ratio (FCE) or feed-to-gain ratio is the number of pounds of feed needed to produce one pound of catfish

The FCE is found by dividing your net production for the season into the number of pounds of feed used, or

FCE = pounds of feed / net production in pounds

EXAMPLE: In one cage, your total production is 360 pounds and you used 550 pounds of feed for that cage. Because you stocked 25 pounds of fish in the cage, your net production is 360 minus 25, or 335 pounds. The FCE equals 550 divided by 335, or 1.64. This means that it took 1.64 pounds of feed to produce one pound of catfish in that cage.

Uses of FCE

* To tell you how much it costs to produce 1 pound of catfish

* To tell you how well your fish are converting feed to growth (See Figure 5-1)

* To help you estimate your feed expense during the growing season and evaluate the quality of your feed

  EXAMPLE: If your feed costs 12 cents/pound, but the FCE is 3.0, then you are really paying 36 cents for feed to produce 1 pound of catfish (because it is taking 3 pounds of feed to produce 1 pound of catfish). You might want to use a more expensive feed to start with, if that feed results in a lower FCE.

Factors Influencing FCE's

1. Overfeeding
2. Underfeeding
3. Poor water quality
4. Poor feed quality
5. Diseases
6. High water temperature -- above 86 degrees Fahrenheit

NOTE: All of these factors could affect your calculated FCE. Keep these factors in mind as you try to understand the significance of your FCE.

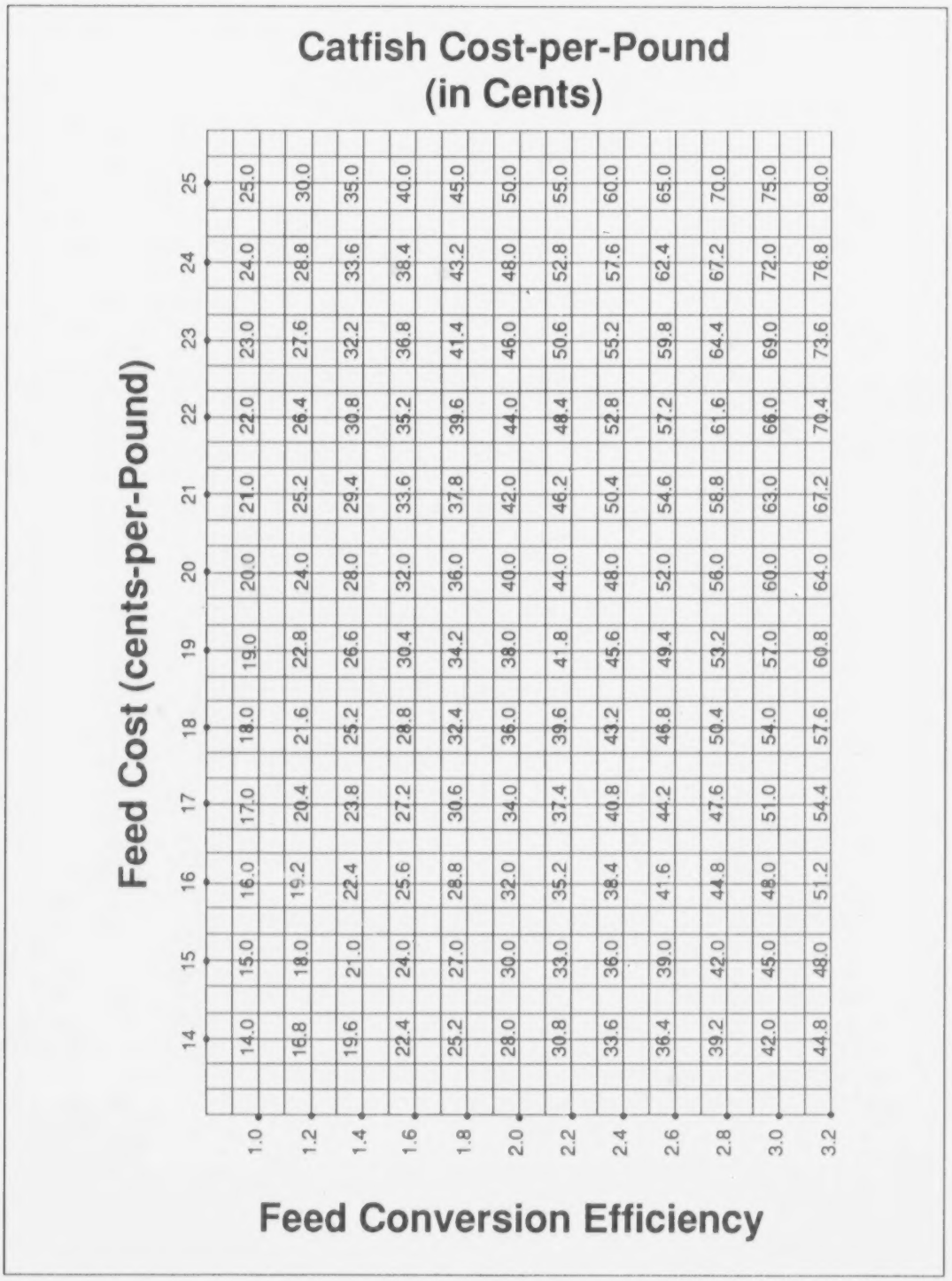


Figure 5-1. The cost of producing one pound of catfish, for different feed costs (per pound) and for different FCE's.

Causes of Changes in Feeding Activity

1. Water temperature

   * Water temperature controls the rate of digestion and metabolism

   * Catfish use less energy at lower temperatures, (below 60-65 degrees Fahrenheit) and need less food

   * Catfish feed less when the water temperature is above about 90 degrees Fahrenheit

2. Dissolved oxygen

   * Catfish need more oxygen when they are feeding and digesting

     NOTE: A catfish reaches its highest oxygen demand about 6 hours after feeding.

   * Low levels of dissolved oxygen (DO) reduce feeding activity

3. Disease -- Many diseases reduce the feeding activity of catfish

4. Handling and other causes of stress

5. Stocking density -- The stocking density can influence the growth rate of catfish

   * Higher stocking densities have a negative effect on water quality

   * Higher stocking densities limit the amount of feed available to each fish

   * Higher numbers (density) of fish must compete with each other for food

   * Larger, more aggressive fish might prevent smaller fish from getting enough feed

     NOTE: You can reduce feeding problems by stocking fish that are about equal in size in each pond or cage.

6. Change in feeding routine

CAUTION: CATFISH RESPOND TO AN ESTABLISHED ROUTINE AND ARE GREATLY AFFECTED BY ANY CHANGE IN THAT ROUTINE. A ROUTINE CAN INCLUDE THE PERSONS WHO FEED THE FISH, AS WELL AS THE TIME AND PLACE OF FEEDING.

7. Change in feeding times

NOTE: To avoid aggravating oxygen problems, consider feeding between 10 AM and 2-4 PM.

Methods of Feeding

1. Hand feeding -- Feeding ponds or cages from a bucket or other container

NOTE: Hand feeding is a recommended method for first-season farmers. Hand feeding (a) helps you observe your fish and your ponds, (b) gives you the chance to learn more about your fish and your ponds, and (c) is affordable for small operations.

2. Blowing feed/Motorized feeding -- A blower "throws" feed from a feed bin to the pond (See Figures 5-2 and 5-3)

3. Demand feeding/Self-feeding -- Feed drops into the water when fish bump a trigger device

CAUTION: USING DEMAND FEEDERS COULD REDUCE YOUR PERSONAL DAILY CONTACT WITH YOUR CATFISH. THIS CONTACT CAN HELP YOU OBSERVE FEEDING ACTIVITY AND HELP YOU DETECT SIGNS OF DISEASE, PARASITES, AND POOR WATER QUALITY.

Figure 5-2. A feed bin and blower attached to a tractor, for feeding pond cultures.

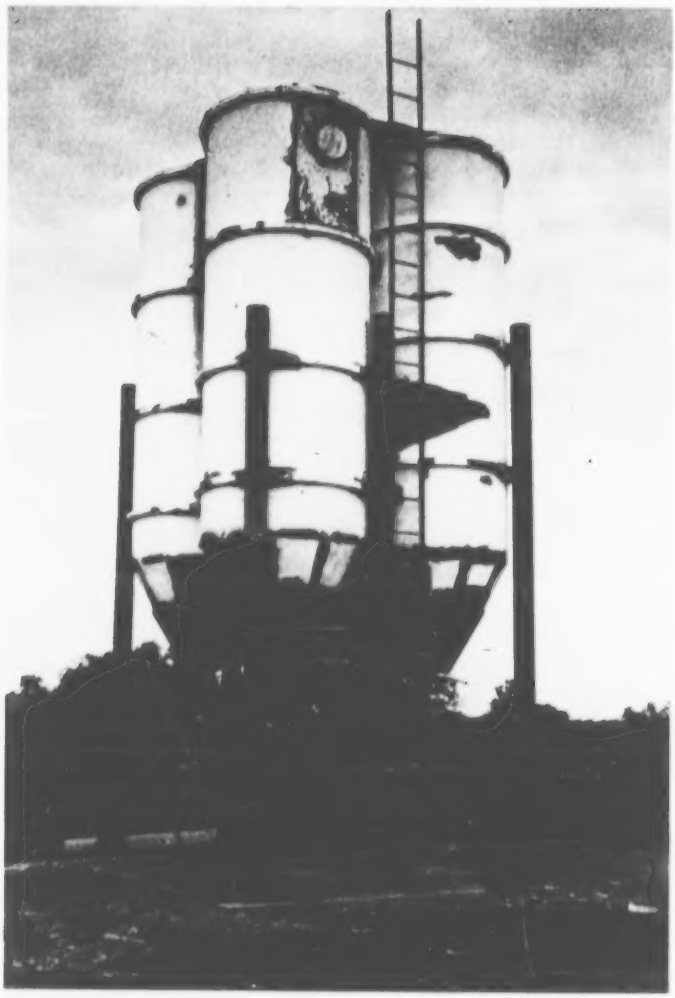


Figure 5-3. A home-built feed storage bin.

Basic Guidelines for Feeding

1. Start with a high-quality feed (even if it costs more than other feeds)

   NOTE: After your first growing season, you will have some experience with your fish and your feed. Later, you might try using a different feed in one pond or in one cage. Using less expensive feeds to start with might not save you money, if the FCE is over 2.0.

2. Ask other fish farmers or extension specialists to recommend fish feeds for catfish culture

   NOTE: Fish feeds are common, but some are useless for catfish culture. Always read the feed labels for a high-quality feed for catfish culture.

3. Keep stored feed dry and use feeds quickly

   CAUTION: FEED STORED FOR SEVERAL MONTHS OR AT HIGH TEMPERATURES (ABOVE 85 DEGREES FAHRENHEIT) CAN LOSE ITS NUTRITIONAL VALUE AND REDUCE YOUR CATFISH PRODUCTION. NEVER USE A MOLDY FEED.

4. Feed at about the same time every day

   NOTE: Mid-morning to late afternoon is good, because dissolved oxygen levels are high, the water is warm, and fish are active.

5. Check the feeding activity of each pond or cage by throwing out a small amount of feed, then checking the response of your fish before using all of the feed

   NOTE: If your fish are not feeding well, find and correct the problem before continuing feeding. Uneaten feed contaminates the water and lowers the dissolved oxygen level.

6. Avoid disturbing your fish while they are feeding

   NOTE: Disturbances could change the feeding activity of your catfish.

7. Record weekly feed totals for each pond or cage

   EXAMPLE: You do not have to weigh the feed. For example, you could mark a line on a feed bucket at the 10-pound level, then count the number of buckets used.

8. Observe feeding trends

NOTE: Use the changes in weekly feeding levels to indicate feed quality and catfish growth. Feed consumption should continually increase until (a) the water temperature decreases, or (b) your catfish weigh 1 - 1 1/4 pounds (if they are healthy).

WORKSHEET 5-1 -- Identifying Possible Feeds for Catfish Culture

Instructions

1. Visit your local feed supplier

2. Find at least two (2) examples of fish feeds that you could use for catfish culture

   NOTE: Ask other catfish farmers for recommendations about fish feeds.

3. Read the label on each bag of feed and fill in the blanks for the ingredients listed in this Worksheet

4. Use the Comparison Chart in this Worksheet to help you find examples of high-quality feeds for catfish culture

   NOTE: The Comparison Chart is not complete and does not discuss all of the possible ingredients of fish feed. Not all labels are the same. You may not be able to judge the quality of a fish feed by the way the ingredients are identified on the feed label.

WORKSHEET 5-1 -- Identifying Possible Feeds for Catfish Culture

Comparison Chart for Production Feeds

NOTE: This chart is not complete.

Ingredient	Notes and Guidelines
"Guaranteed Analysis"	Look for the guaranteed protein percentage (32%, 36%, etc.)
Crude fat	Should be less than 6% (1% is too low)
Crude fiber	Should not be too high (8-10%)
	High percentages of crude fiber can indicate the use of a non-nutritive filler in a fish feed (Fish do not digest this filler)
Fish meal	Look for fish meal in the ingredients (May or may not be listed as a percentage)
Vitamin C (Ascorbic acid)	Must be present in the feed
Vitamins	Look for vitamins in the feed
	Vitamins listed (except D-Biotin) are essential supplements found in many feeds
	Vitamins can be found in fish feeds, in natural fish foods, and in vitamin packs
Rice hulls, peanut hulls, etc. (fillers)	May be present but are not essential
Wheat, corn, milo, rice bran, etc. (grains)	May be present and add energy (calories) and some fiber
Soybean meal	Must be present in the feed, to balance protein and amino acids
Animal fat	May be present in the feed to coat the feed and reduce dust or fine particles; also boosts the energy level
Feather meal	Should not be present

WORKSHEET 5-1 -- Identifying Possible Feeds for Catfish Culture

Examples of Feed Labels

36% FISH FOOD

GUARANTEED ANALYSIS

Crude Protein, not less than 36.00%
Crude Fat, not less than 5.00%
Crude Fiber, not more than 5.00%

INGREDIENTS

Soybean Meal, Ground Wheat, Fish Meal 10%, Ground Yellow Corn, Corn Gluten Meal, Animal Fat, Condensed Corn Fermentation Solubles, Ascorbic Acid, Vitamin A Acetate, D-Activated Animal Sterol (Source of Vitamin D3), Di-Alpha Tocopheryl Acetate, Vitamin B-12 Supplement, Riboflavin Supplement, Niacin, Di-Calcium Pantothenate, Menadione Sodium Bisulfite Complex, Folic Acid, D-Biotin, Pyridoxine Hydrochloride, Thiamine Mononitrate, Choline Chloride, Ethoxyquin (a Preservative), Zinc Oxide, Manganous Oxide, Copper Oxide, Ethylenediamine Dihydriodide, Ferrous Sulfate Monohydrate, Cobalt Carbonate, Calcium Carbonate.

32% FISH FOOD

GUARANTEED ANALYSIS

Crude Protein, not less than 32.00%
Crude Fat, not less than 5.00%
Crude Fiber, not more than 6.00%

INGREDIENTS

Soybean Meal, Ground Wheat, Fish Meal 10%, Ground Yellow Corn, Wheat Middlings, Meat and Bone Meal, Animal Fat, Condensed Corn Fermentation Solubles, Ascorbic Acid, Vitamin A Acetate, D-Activated Animal Sterol (Source of Vitamin D3), Di-Alpha Tocopheryl Acetate, Vitamin B-12 Supplement, Riboflavin Supplement, Niacin, Di-Calcium Pantothenate, Menadione Sodium Bisulfite Complex, Folic Acid, D-Biotin, Pyridoxine Hydrochloride, Thiamine Mononitrate, Choline Chloride, Ethoxyquin (a Preservative), Zinc Oxide, Manganous Oxide, Copper Oxide, Ethylenediamine Dihydriodide, Ferrous Sulfate Monohydrate, Cobalt Carbonate, Calcium Carbonate.

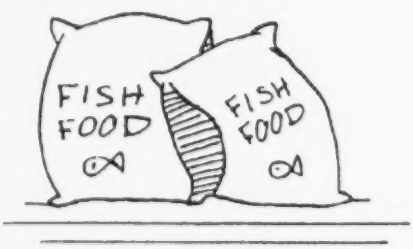
40% FISH FOOD

GUARANTEED ANALYSIS

Crude Protein, not less than 40.00%
Crude Fat, not less than 5.00%
Crude Fiber, not more than 5.00%

INGREDIENTS

Fish Meal 35%, Ground Wheat, Soybean Meal, Corn Gluten Meal, Ground Yellow Corn Meal, Animal Fat, Ascorbic Acid, Vitamin A Acetate, D-Activated Animal Sterol (Source of Vitamin D3), Riboflavin Supplement, Di-Calcium Pantothenate, Niacin, Choline Chloride, Vitamin B-12 Supplement, Vitamin E Supplement, Folic Acid, Thiamine Hydrochloride, Pyridoxine Hydrochloride, Biotin, Ethoxyquin (a Preservative), Manganous Oxide, Copper Sulfate, Cobalt Carbonate, Ferric Sulfate Monohydrate, Ethylenediamine Dihydriodide, Zinc Oxide, Calcium Carbonate, Menadione Sodium Bisulfite (Source of Vitamin K Activity).



WORKSHEET 5-1 -- Identifying Possible Feeds for Catfish Culture

	Feed #1	Feed #2
BRAND NAME:		
LOCAL SUPPLIER		
Guaranteed analysis? (% if listed)		
Crude fat? (% if listed)		
Crude fiber? (% if listed)		
Fish meal? (% if listed)		
Vitamin C/Ascorbic acid? (Yes or No)		
Vitamins? (Yes or No)		
Soybean meal? (Yes or No)		

WORKSHEET 5-2 -- Recording Feed Totals

Instructions

1. Record daily and weekly feed totals (in pounds) for each pond or cage

   NOTE: You could also use the weekly totals to record monthly totals.

2. Use the weekly totals for each pond or cage to help you find the FCE at the end of the growing season

   NOTE: Use the changes in weekly feeding levels to indicate feed quality and catfish growth. Feed consumption should continually increase until the water temperature increases or until your catfish weigh 1 - 1 1/4 pounds (if they are healthy).

3. Keep this Feeding Record (or your own version) as a part of your permanent recordkeeping system

   NOTE: A complete feeding record can help you plan your feed requirements for the next growing season.

WORKSHEET 5-2 -- Recording Feed Totals

FEEDING RECORD

Week of _____ 19_____

DAILY TOTALS (in pounds) SUN	MON	TUE	WED	THUR	FRI	SAT	WEEKLY TOTAL
Pond/Cage Number:_____							
_____	_____	_____	_____	_____	_____	_____	_____
Pond/Cage Number:_____							
_____	_____	_____	_____	_____	_____	_____	_____
Pond/Cage Number:_____							
_____	_____	_____	_____	_____	_____	_____	_____
Pond/Cage Number:_____							
_____	_____	_____	_____	_____	_____	_____	_____
Pond/Cage Number:_____							
_____	_____	_____	_____	_____	_____	_____	_____
Pond/Cage Number:_____							
_____	_____	_____	_____	_____	_____	_____	_____
Pond/Cage Number:_____							
_____	_____	_____	_____	_____	_____	_____	_____
Pond/Cage Number:_____							
_____	_____	_____	_____	_____	_____	_____	_____
Pond/Cage Number:_____							
_____	_____	_____	_____	_____	_____	_____	_____

C. Handling Your Fish

Basic Guidelines for Handling

1. Handle your fish gently

   NOTE: Injuries to your fish from rough handling, scrapes, and punctures can help cause disease.

2. Keep the DO level high when handling your fish

3. Use salt (1% by weight of water) to reduce stress to fish and fingerlings while handling and stocking

4. Do not disturb your fish after stocking and during the growing season

Common Causes of Disturbance

* Moving cages
* Swimming near cages
* Catching/netting fish often for show
* Fishing near cages
* Shooting at turtles or snakes in ponds or near cages
* Allowing visitors around cages
* Cleaning cages

5. Treat catfish handled in winter immediately after handling

   NOTE: Fish handled in winter do not heal from injuries as well.

6. Give regular prophylactic treatments (a lower-than-therapeutic dose of a chemical used to help prevent disease)

   NOTE: Contact state experts about the quantity and frequency of prophylactic treatments.

7. Avoid handling catfish in very warm water

D. Overwintering Your Fish

Definition

Overwintering -- Keeping catfish over the winter to reach a larger size

CAUTION: KEEPING YOUR FISH OVER THE WINTER ALSO EXTENDS THE RISKS IN CATFISH CULTURE.

Reasons for Winter Feeding

1. To hold catfish for a specific market or to reach a specific market size

2. To help promote catfish growth over the winter

   NOTE: Catfish that are not fed over the winter can lose about 9% of their body weight between November and March. Catfish that are fed according to some general winter feeding guidelines can gain up to about 20% of their body weight between November and March.

3. To help reduce losses from diseases caused by poor nutrition

Guidelines for Winter Feeding

1. Feed your fish at least 1% of their body weight when the water temperature reaches about 55 degrees Fahrenheit or above

2. Adjust your feeding schedule as needed

   NOTE: How often you feed your fish in winter can depend on the water temperature. Check with state experts, other farmers, and other sources for specific water temperatures and feeding times.

3. Use a sinking or partially-sinking feed for pond cultures

   NOTE: Look for a rising cloud of sediment when you observe winter feeding activity.

4. Feed your fish in the afternoon and in shallow water

   NOTE: Water temperatures are usually higher in the afternoon and in shallow water.

5. Avoid feeding your fish under an ice cover

CAUTION: LARGE AMOUNTS OF UNEATEN FEED AND DECAYING WASTES CAN DANGEROUSLY LOWER THE DISSOLVED OXYGEN LEVEL WHEN PONDS ARE COVERED WITH ICE. ICE CAN LIMIT PHOTOSYNTHESIS, REDUCING THE AMOUNT OF DISSOLVED OXYGEN IN THE WATER. LOW DISSOLVED OXYGEN LEVELS COMBINED WITH UNEATEN FEED AND DECAYING WASTES CAN CAUSE A FISH DIE-OFF.

6. Treat catfish handled in winter immediately after handling

NOTE: Fish handled in the winter do not heal from injuries as well.

5. Growing Food Fish

Unit Review

1. Match the stocking sizes of fingerlings to their possible harvest sizes in one full season.

_____a.	4"-6" fingerlings	1.	3/4 to 1 pound
_____b.	6"-8" fingerlings	2.	1 to 1 1/2 pound
_____c.	8"-10" fingerlings	3.	1 1/2 to 3 pound

2. Describe stocking rates in ponds and cages.

   a. In ponds -- _____

   b. In cages -- _____

   _____

3. Describe stocking periods.

   _____

   _____

4. List five (5) signs of high-quality fingerlings.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

5. Discuss growth factors.

   a. Size of fingerlings -- _____

   _____

   b. Stocking rate -- _____

   _____

c. Water temperature -- _____

_____

d. Dissolved oxygen -- _____

_____

e. Water quality -- _____

_____

6. Identify guidelines for stocking by writing an X in the space beside each guideline.

_____a. Start out on a small scale for cage culture only

_____b. Start out on a small scale, until you have more experience

_____c. Choose only high-quality fingerlings that are the appropriate size

_____d. Lower the dissolved oxygen level

_____e. Do not overcrowd your fish

_____f. Avoid transporting fingerlings yourself

_____g. Lower the water temperature

_____h. Get your fingerlings on feed when stocking

7. List basic feed requirements. (You do not have to describe each requirement.)

a. _____

b. _____

c. _____

d. _____

8. Identify amounts to feed by completing each statement.

a. All of the feed that your fish will eat in _____ minutes.

b. About _____ of the weight of the fish in each pond or cage each _____, if the water temperature is between about 65-86 degrees Fahrenheit.

c. Not more than _____ pounds per _____ _____ per day, unless aeration is available (depending on the pond)

9. Define feed conversion efficiency.

_____

_____

10. List the uses of FCE.

a. _____

_____

b. _____

_____

c. _____

_____

11. Identify factors influencing FCE's by writing an X beside each factor.

_____a. Feed expense

_____b. Overfeeding

_____c. Underfeeding

_____d. Poor water quality

_____e. Diseases

_____f. High water temperature

_____g. Poor feed quality

12. Identify causes of changes in feeding activity by writing an X beside each cause.

_____a. Fingerling quality

_____b. Water temperature

_____c. Dissolved oxygen

_____d. Disease

_____e. Handling and other causes of stress

_____f. Method of feeding

_____g. Change in feeding routine

_____h. Stocking density

_____i. Change in feeding times

13. Describe three (3) methods of feeding.

a. _____

_____

b. _____

_____

c. _____

_____

14. Identify basic guidelines for feeding by writing an X beside each guideline.

_____a. Start with a lower-quality feed until you have more experience in feeding

_____b. Start with a high-quality feed (even if it costs more than other feeds)

_____c. Ask other fish farmers or extension specialists to recommend fish feeds for catfish culture

_____d. Keep stored feed dry and use feeds slowly

_____e. Keep stored feed dry and use feeds quickly

_____f. Feed at different times each day

_____g. Feed at about the same time every day

_____h. Observe feeding trends

_____i. Check the feeding activity of each pond or cage by throwing out a small amount of feed, then checking the response of your fish before using all of the feed

_____j. Avoid disturbing your fish while they are feeding

_____k. Record weekly feed totals for each pond or cage

15. Identify basic guidelines for handling by writing an X beside each guideline.

_____a. Handle your fish often

_____b. Handle your fish gently

_____c. Keep the DO level high when handling your fish

_____d. Keep the DO level low when handling your fish

_____e. Use salt (1% by weight of water) to reduce stress to fish and fingerlings while handling and stocking

_____f. Do not disturb your fish after stocking and during the growing season

_____g. Avoid handling fish in winter

_____h. Treat catfish handled in winter immediately after handling

_____i. Give regular prophylactic treatments

_____j. Avoid handling catfish in very warm water

_____k. Avoid handling catfish in very cold water

16. Define overwintering.

_____

_____

17. State three (3) reasons for winter feeding.

a. _____

b. _____

c. _____

18. Identify guidelines for winter feeding by writing an X beside each guideline.

_____a. Feed your fish at least 1% of their body weight when the water temperature reaches about 55 degrees Fahrenheit or above

_____b. Follow the same feeding schedule every day in the winter

_____c. Adjust your feeding schedule as needed

_____d. Use a floating feed for pond cultures

_____e. Use a sinking or partially-sinking feed for pond cultures

_____f. Feed your fish in the afternoon and in shallow water

_____g. Feed your fish in the afternoon and in deep water

_____h. Avoid feeding your fish under an ice cover

_____i. Avoid handling fish in winter

_____j. Treat catfish handled in winter immediately after handling

To check your answers, review the unit. 204

6. Controlling Catfish Diseases and Parasites

A. Recognizing Signs of Disease and Parasites

Disease and Parasite Expenses

1. Loss of fish

   NOTE: Diseases and parasites can kill all of your fish very quickly or very slowly.

2. Costs of treating fish

   NOTE: Costs include any chemical treatments needed, your time and the time of persons diagnosing the disease, etc.

3. Effects on growth of fish before and after the treatment

   CAUTION: YOU MUST KNOW HOW YOUR CATFISH WILL BE AFFECTED BY ANY TREATMENT.

4. Interruption of normal production activities

Behavioral Signs

NOTE: Behavioral signs can indicate a disease or parasite problem. However, these signs will not indicate a specific disease or parasite.

1. Changes in feeding habits (not feeding)

2. Changes in level of activity

   * Crowding or gathering near the surface of the water, near the water source (incoming water), around plants or objects

   * Not swimming away when frightened or disturbed

   * Staying at the surface or breaking the surface of the water often

   * Darting or convulsing

   * Scratching against objects

3. Changes in swimming habits

   * Swimming slowly and without direction

   * Swimming weakly

* Losing balance

* Floating (head-up)

Physical Signs

1. Dead or dying fish

   NOTE: Look for dead catfish on shore as well as in the water.

2. Bloody areas -- outside or inside

3. Open sores or wounds

4. Open mouths

5. Popeye/sunken eyes

6. Changes in outside appearance

   * Losing mucous coating

   * Losing natural color

   * Discolored gills

   * Folding tail or fins

   * Fraying tail or fins

   * Clouding eyes

   * Thinning or bloating

7. Unusual spots, bubbles, scratches, etc.

WORKSHEET 6-1 -- Checking for Signs of Disease and Parasites

Instructions

1. Complete the "Behavior and Appearance Record" every day, or until you become familiar with the behavior and physical signs of catfish diseases and parasites

   NOTE: You might want to use this Record after you have become familiar with the signs, as part of your recordkeeping system or to help you identify ponds or cages having recurring (repeating) problems with disease and parasites.

2. Design your own Record, if needed

WORKSHEET 6-1 -- Checking for Signs of Disease and Parasites

BEHAVIOR AND APPEARANCE RECORD

NOTE: This Record may not be complete.

Pond/Cage Number:_____

BEHAVIOR CHANGES	DATES OBSERVED
1. Not feeding normally?	_____
2. Crowding or gathering near the surface, near the water inlet, or around plants or objects near the pond's edge?	_____
3. Swim away when frightened or disturbed?	_____
4. Staying at the surface or breaking the surface often?	_____
5. Darting or convulsing?	_____
6. Scratching against objects?	_____
7. Swimming slowly and without direction?	_____
8. Swimming weakly?	_____
9. Losing balance?	_____
10. Floating?	_____
11. _____	_____
12. _____	_____

NOTES

_____

_____

_____

WORKSHEET 6-1 -- Checking for Signs of Disease and Parasites

BEHAVIOR AND APPEARANCE RECORD

NOTE: This Record may not be complete.

Pond/Cage Number:_____

PHYSICAL CHANGES	**DATES OBSERVED**
1. Dead or dying fish (in the water or on the shore)?	_____
2. Bloody areas outside or inside?	_____
3. Open sores or wounds?	_____
4. Open mouths?	_____
5. Popeye/sunken eyes?	_____
6. Losing mucous coating?	_____
7. Losing natural color?	_____
8. Discolored gills?	_____
9. Folding tail or fins?	_____
10. Fraying tail or fins?	_____
11. Clouding eyes?	_____
12. Thinning or bloating?	_____
13. Unusual spots, bubbles, or scratches on fish?	_____
13. _____	_____
14. _____	_____

NOTES

_____

_____

_____

B. Following General Guidelines for Preventing, Diagnosing and Treating Diseases and Parasites

Preventing Diseases and Parasites

1. Manage your water supply

   * Keep the quality of water high

     NOTE: Be sure that the water contains the proper elements of water quality, and the right levels.

   * Keep the correct level of dissolved oxygen

   * Compare water temperatures in the pond and at the inlet

     NOTE: Most diseases are caused by stress and are dependent on specific temperature ranges. You should not pump cold water during the summer.

   * Use monthly prophylactic treatments through the cooler months (October through March/April)

     NOTE: A prophylactic treatment is a lower-than-therapeutic dose of a chemical, used to help prevent disease.

   * Prevent chemicals, pesticides, ammonia and other contaminants from getting into your water

   * Control any trash fish in your water supply

2. Buy high-quality fingerlings

   NOTE: Avoid problems from the beginning by stocking only healthy fingerlings.

3. Watch your fish <u>every day</u> for behavior and physical changes

4. Reduce the causes of stress

   NOTE: Stress weakens fish and makes them more vulnerable to diseases. A good way to help prevent many diseases is to reduce the causes of stress.

5. Use high-quality feeds that provide complete nutrition

   NOTE: Some diseases are caused by poor nutrition.

6. Handle fish carefully and only when necessary

NOTE: If you must handle your fish, move them with a salt solution where the amount of salt equals 1% of the water weight.

7. Disinfect all nets, seines, containers and other equipment before and after harvesting and immediately after handling sick fish

NOTE: Hang your nets out to dry completely, if possible.

8. Remove diseased fish immediately

Some Causes of Stress Related to Catfish Diseases

---

* Poor water quality or rapid changes in water quality
* Low levels of oxygen
* High water temperature or rapid changes in water temperature
* Handling
* Harvest activities
* Overcrowding (especially in cage cultures)
* Excessive chemical treatments
* Poor nutrition (especially vitamin deficiencies)

Diagnosing Diseases and Parasites

1. Check for problems every day

NOTE: You can see problems develop by watching your fish every day, such as when you feed your fish.

2. Identify the problem and contact state experts

NOTE: Call the experts before you decide to ship any samples. You must know what information is needed to diagnose your fish, how you should send the fish and your information, and when to ship.

3. Check your water quality, feed quality, and your management practices

NOTE: Many catfish diseases result from poor water quality, poor feed quality, or poor management.

4. Know basic information about your fish and your water

NOTE: If you are sending fish and water samples to experts for diagnosis, call the experts first to find out what information is needed.

Treating Diseases and Parasites

1. Identify the problem and its possible causes

   NOTE: Many catfish diseases are caused by poor water quality, poor feed quality, or poor management.

2. Contact experts immediately

   NOTE: Experts may be able to help you diagnose a disease or parasite problem, and recommend a possible treatment. However, experts might <u>not</u> be able to find the problem.

3. Compare the possible solutions

   * Do you need the treatment?

   * Can you afford the treatment and any possible repeat treatments?

   * What are your chances of reducing your losses with the treatment?

   * How will your fish respond?

   * What factors can change the effectiveness of the treatment?

     EXAMPLES: Water temperature, oxygen concentration, clouds, water chemistry, algae, etc.

   * How can you best apply the treatment?

     EXAMPLES: Dipping or injecting infected fish, draining, drying and treating the pond, etc.

   * Will other ponds need to be treated soon?

4. For chemical treatments, use only <u>approved</u> chemicals, know the volume of water to be treated, and follow all instructions and labels exactly

   NOTE: You should already know the volume of your ponds at different depth stages. See Unit 4.

Sources of Information

1. Written materials

   NOTE: See the "Suggested Reading" pages.

2. Qualified advice

   EXAMPLE: Other catfish farmers, state experts, county extension agents, Department of Wildlife Conservation, and others. See the "Important Addresses" pages.

WORKSHEET 6-2 -- Recording Signs of Disease and Parasites

Instructions

1. Contact experts, catfish farmers, and other sources for more information about catfish diseases and parasites

   NOTE: Experts and other catfish farmers can be your best sources of information about diseases and their treatments. See the "Important Addresses" pages.

2. Complete the "Diagnosis Record" as much as possible before you contact experts to diagnose a disease and recommend a treatment

   NOTE: Contact the experts in advance about the information that they will need.

3. Use this Worksheet when contacting experts about any disease or parasite problems or as a part of your recordkeeping system

   NOTE: You could use the "Diagnosis Record" to record information about a current problem that might help you identify and treat a future problem.

   CAUTION: EXPERTS MIGHT NOT BE ABLE TO SOLVE YOUR PROBLEM.

WORKSHEET 6-2 -- Recording Signs of Disease and Parasites

DIAGNOSIS RECORD

DATE _____

Location Data

1. Your Name and Business _____

   _____

2. Address _____

   _____

3. Phone _____

Operation Data

1. Check one: _____Pond culture _____Cage culture

2. Source(s) of water (well, surface runoff, stream, another pond, etc.)

   _____

3. Surface area:_____ Volume:_____

4. Depth (average) _____

5. Water temperature _____

6. Water chemistry (give levels of each)

   Total alkalinity _____

   pH _____

   Nitrite _____

   Ammonia _____

   Carbon dioxide _____

   Oxygen _____

7. Water color _____

WORKSHEET 6-2 -- Recording Signs of Disease and Parasites

DIAGNOSIS RECORD

8. Odor (describe) _____

_____

9. Visibility (depth) _____

10. Scum or Moss (present or not present?) _____

11. Sudden changes? _____

Catfish Data

1. Age _____

2. Size(s) _____

3. Source(s) _____

_____

4. Density (per acre, per cubic meter, or per cubic foot)

_____

5. Date of handling (most recent) _____

Disease and Treatment History

1. Past diseases (types and dates) _____

_____

_____

2. Past treatments (types and dates)

Disease treatments _____

_____

_____

Weed control treatments _____

_____

_____

WORKSHEET 6-2 -- Recording Signs of Disease and Parasites

DIAGNOSIS RECORD

3. **Current Problem**

Total number of deaths _____

Daily loss _____

Length of die-off _____

Signs (from WORKSHEET 6-1)

NOTE: Describe the signs that you have noticed. Someone else may not see the same signs that you have noticed.

Death of other wildlife (types) _____

_____

Other Data

1. Have you or someone else used agricultural chemicals nearby?
2. When did you last drain or seine your pond?
3. When did you last add water? When did you last add fish?
4. What type(s) of feed are you using? How often do you feed?
5. When have you found low levels of oxygen (dates)?
6. What were the weather conditions at the time you noticed the problem?
7. How and when did you collect your fish samples?

6. Controlling Catfish Diseases and Parasites

Unit Review

1. Name disease and parasite expenses.

   a. _____

   b. _____

   c. _____

   d. _____

2. Identify behavioral signs of disease and parasites by writing an X in the space beside each behavioral sign.

   _____a. Changes in feeding habits (not feeding)

   _____b. Dead or dying fish

   _____c. Fighting

   _____d. Changes in level of activity

   _____e. Changes in outside appearance

   _____f. Changes in swimming habits

3. Identify physical signs of disease and parasites by writing an X in the space beside each physical sign.

   _____a. Dead or dying fish

   _____b. Changes in swimming habits

   _____c. Bloody areas -- outside or inside

   _____d. Open sores or wounds

   _____e. Open mouths

   _____f. Changes in outside appearance

   _____g. Changes in level of activity

   _____h. Unusual spots, bubbles, scratches, etc.

   _____i. Popeye/sunken eyes

4. Identify basic guidelines for preventing, diagnosing, and treating diseases and parasites. In the space beside each guideline, write the letter of the type of guideline. Use a P for a "preventing" guideline, a D for a "diagnosing" guideline, and a T for a "treating" guideline.

_____a. Manage your water supply

_____b. Follow all instructions and labels on chemicals <u>exactly</u>

_____c. Reduce the causes of stress

_____d. Check your water quality, feed quality, and your management practices

_____e. Compare the possible solutions

_____f. Buy high-quality fingerlings

_____g. For chemical treatments, use only <u>approved</u> chemicals, know the volume of water to be treated, and follow all instructions and labels exactly

_____h. Know basic information about your fish and your water

_____i. Remove diseased fish <u>immediately</u>

_____j. Handle fish carefully and only when necessary

_____k. Contact experts immediately

5. List two (2) sources of information about preventing, diagnosing, and treating diseases and parasites.

a. _____

b. _____

To check your answers, review the unit. 213

7. Controlling Predators, Trash Fish, and Pests

Unit Objectives

After completing this unit, you should be able to

1. Define a predator
2. Match types of predators with the problems each type can cause
3. Match types of predators with possible methods for controlling each type
4. Define a trash fish
5. Name problems with trash fish
6. Identify box, saran sock, and inlet filter controls
7. List management controls
8. Define a pest
9. Describe types of pests and the problems each type can cause
10. Match types of pests with possible methods for controlling each type
11. List sources of information about controlling predators, trash fish, and pests

7. Controlling Predators, Trash Fish, and Pests

A. Controlling Predators

Definition

Predator -- Animals that kill and eat adult catfish, catfish fingerlings, or eggs

NOTE: Most losses from predators are to catfish fingerlings.

Types and Problems

1. Birds -- Kingfishers, herons, egrets, pelicans, cormorants, and others
   * Kill fingerlings and adult catfish
   * Can seriously affect production if present in large numbers
2. Turtles -- Snapping turtles
   * Kill fingerlings and adult catfish
   * Compete (along with other turtles) with catfish for space and food (including feed)
3. Snakes -- Water snakes
   * Kill fingerlings and adult catfish
   * Site conditions can attract poisonous snakes
4. Bullfrogs
   * Kill fingerlings (and fry)
   * Bullfrog tadpoles compete with catfish for space and food
5. Other Fish -- Different species, if given the chance to prey on catfish
   * Kill fingerlings and adult catfish
   * Can be accidentally mixed with stock fish and compete for space and food

Controlling Predators

1. Birds

   * Control according to federal and state law

     CAUTION: MOST BIRDS ARE PROTECTED BY FEDERAL OR STATE LAW.

   * Check with game rangers before controlling

2. Turtles

   * Trap or shoot

     NOTE: Know which kinds of turtles can be caught or killed in the state.

   * Catch with gill nets or traps

3. Snakes

   * Mow grassy banks and surrounding areas closely

   * Remove boards, brush, and other "hiding places"

   * Catch with gill nets

   * Kill snakes when caught

4. Bullfrogs

   * Remove and destroy eggs

   * Poison eggs with copper sulfate placed on egg masses

   * Kill frogs when caught

5. Other Fish

   * Screen and filter the water supply

   * Inspect stock fish before they are released in ponds

   * Remove other fish when draining or seining ponds

   * Poison any puddles after draining ponds, using the right amounts of copper sulfate, lime, or ammonium phosphate

B. Controlling Trash Fish

Definition

Trash Fish -- Any fish that is not a part of your catfish culture, such as scaled fish (sunfish, carp, etc.) and bullheads

NOTE: Trash fish are also called wild fish. Some trash fish are also predators.

Problems with Trash Fish

1. Compete with catfish for food and space (and reduce your profits)

   NOTE: Trash fish can increase your costs for feed, if the fish are present in large numbers.

2. Compete with catfish for oxygen
3. May slow the growth rate of catfish
4. Cause problems for harvesting

   NOTE: You must separate the trash fish from your catfish.

5. May introduce diseases and parasites
6. May kill and eat catfish (may be predators)

Filter Controls

1. Box Filters

   * Made of a frame (usually wood) covered with screening material
   * Filters trash fish from a low-volume water supply
   * Can be permanent or floating (See Figure 7-1)

   NOTE: Box filters require constant maintenance. Check and clean filters often.

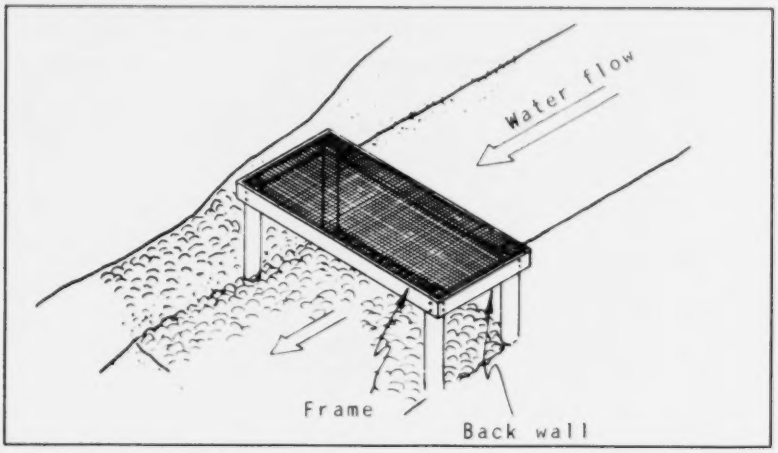


Figure 7-1. Box filter.
(From U.S. Department of Agriculture, Soil Conservation Service, Farmers' Bulletin Number 2260)

2. Saran Sock Filters

* Made from a saran screen "sock" (polypropylene)

* Placed over the ends of incoming water supply pipes where the pipe discharges water into your ponds near the surface of the water (See Figure 7-2)

NOTE: Sock filters clog easily and require constant maintenance.

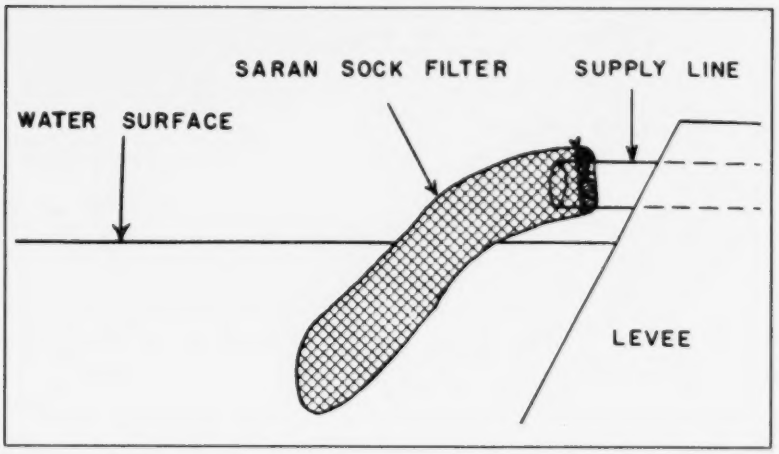


Figure 7-2. Saran sock filter. (From U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife.)

3. Inlet Filters

   * Made from stainless mesh or fine hardware cloth

   * Placed over the mouth of water inlet pipes

   NOTE: Stainless mesh and fine hardware cloth are more durable than saran.

Management Controls

1. Drain and remove trash fish from your ponds before you use the ponds for catfish culture

2. Use well water instead of surface or spring water, if possible

3. Control your water supply (keeping current water level or draining) with a turndown pipe fitted with a hardware cloth screen on top (See Figure 7-3)

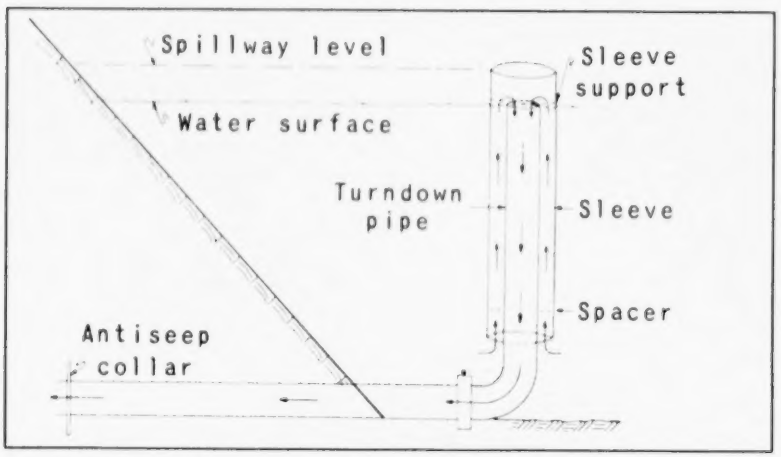


Figure 7-3. Turndown pipe.
(From U.S. Department of Agriculture, Soil Conservation Service, Farmers' Bulletin Number 2260)

4. Separate trash fish when harvesting your catfish

C. Controlling Pests

Definition

Pests -- Animals that compete with catfish for space and/or food, or that damage your production facilities

Types and Problems

1. Livestock -- Cattle, swine
   * Damage levees, dams, and pond walls
2. Burrowing animals -- Beaver, muskrats, others
   * Damage levees, dams, and pond walls

Controlling Pests

1. Livestock
   * Feed away from pond banks and catfish culture ponds
   * Limit the access around catfish culture ponds
   * Reduce the numbers (of animals) around catfish culture ponds
2. Burrowing animals
   * Mow pond banks and surrounding areas closely
   * Remove food sources
   * Line dams on watershed ponds with rock above and below the water surface

     NOTE: Rocks on leveed banks will cause problems during harvesting.
   * Trap or kill

     CAUTION: BE SURE THAT YOUR METHOD OF CONTROL IS LEGAL. CHECK WITH GAME RANGERS OR THE STATE DEPARTMENT OF WILDLIFE CONSERVATION.

Sources of Information

1. Oklahoma Department of Wildlife Conservation
2. State experts
3. Other catfish farmers

NOTE: See the "Important Addresses" pages.

7. Controlling Predators, Trash Fish, and Pests

Unit Review

1. Define a predator.

_____

_____

2. Match types of predators with the problems each type can cause by writing the number on the right that matches the description on the left.

HINT: Some descriptions may match more than one type of predator. Write the numbers of all of the predators that apply.

_____a.	Kill fingerlings and adult catfish	1. Birds
_____b.	Compete with catfish for space and food	2. Turtles
_____c.	Kill fingerlings (and fry)	3. Snakes
_____d.	Can be accidentally mixed with stock fish and compete for space and food	4. Bullfrogs
		5. Other fish
_____e.	Can seriously affect production if present in large numbers	

3. Match types of predators with possible methods for controlling each type by writing the number on the right that matches the possible control method on the left.

_____a.	Control according to federal and state law	1. Birds
		2. Turtles
_____b.	Remove and destroy eggs	3. Snakes
_____c.	Catch with gill nets or traps	4. Bullfrogs
_____d.	Screen and filter the water supply	5. Other fish
_____e.	Check with game rangers before controlling	
_____f.	Remove boards, brush, and other "hiding places"	
_____g.	Trap or shoot	
_____h.	Mow grassy banks and surrounding areas closely	
_____i.	Inspect stock fish before they are released in ponds	

4. Define a trash fish.

_____

_____

5. Name four (4) problems with trash fish.

a. _____

b. _____

c. _____

d. _____

6. Identify box, saran sock, and inlet filter controls. In the space beside each description, write a B for box filters, an SS for saran sock filters, or an I for inlet filters.

_____a. Filters trash fish from a low-volume water supply

_____b. Placed over the mouth of water inlet pipes

_____c. Placed over the ends of incoming water supply pipes where the pipe discharges water into your ponds near the surface of the water

_____d. Made of a frame (usually wood) covered with screening material

_____e. Made from stainless mesh or fine hardware cloth

_____f. Can be permanent or floating

_____g. Made from a saran screen "sock"

7. List four (4) management controls.

a. _____

_____

b. _____

_____

c. _____

_____

d. _____

_____

8. Define a pest.

_____

_____

9. Describe types of pests and the problems each type can cause.

a. _____

_____

b. _____

_____

10. Match types of pests with possible methods for controlling each type by writing the number on the right that matches the possible control method on the left.

_____a.	Limit the access around catfish culture ponds	1. Livestock
_____b.	Remove food sources	2. Burrowing animals
_____c.	Line dams on watershed ponds with rock above and below the water surface	
_____d.	Mow pond banks and surrounding areas closely	
_____e.	Feed away from pond banks and catfish culture ponds	

11. List three (3) sources of information about controlling predators, trash fish, and pests.

a. _____

b. _____

c. _____

To check your answers, review the unit.

8. Harvesting Your Fish

Unit Objectives

After completing this unit, you should be able to

1. Describe types of harvests
2. Explain when to harvest
3. Describe methods of harvesting
4. Identify basic guidelines for planning your harvest
5. List basic equipment for harvesting cages
6. List in order the basic steps for harvesting cages
7. List basic equipment for harvesting ponds
8. List in order the basic steps for seining
9. List in order the basic steps for trap-seining
10. State options in holding and transporting
11. Identify requirements for holding
12. Identify requirements for transporting
13. Identify basic guidelines for transporting
14. Record harvest information (WORKSHEET 8-1)

8. Harvesting Your Fish

A. Reviewing General Guidelines for Harvesting

Types of Harvests

1. Single harvest -- Harvesting all of your fish at one time

   NOTE: A single harvest usually requires draining the pond. You may also need holding facilities (holding tanks) for the harvested fish.

2. Multiple harvests ("cropping") -- Harvesting your fish continuously, as needed

   * To meet changing demands from your markets during the growing season

     EXAMPLE: One of your markets might buy some of your fish at one time during the growing season, or for one event or occasion.

   * To meet "regular" demands from your markets

     EXAMPLE: One of your markets could be a restaurant that wants a certain supply of catfish delivered once each week.

   * To separate market-size fish from smaller, still growing fish

When to Harvest

1. When your markets want your fish

2. When your fish reach market size

3. At the end of the growing season (October to mid-November in Oklahoma), to cut your losses and sell all of your fish

   NOTE: Prices are <u>lowest</u> at the end of the growing season.

Methods of Harvesting

1. For cage cultures -- Harvesting your fish with a dip net from cages

2. For pond cultures -- Harvesting your fish by seining or trap-seining

   NOTE: You can also harvest your pond by draining the pond, if the pond was designed appropriately.

Planning Your Harvest

1. Coordinate your harvests with your markets

   NOTE: Harvest your fish when your markets want your fish. If you will be using the "custom" harvesting services of a processor, contact the processor several weeks in advance to plan your harvest.

2. Sample your fish for off-flavor and correct the problem before you harvest

   CAUTION: NEVER SELL FISH THAT YOU KNOW ARE OFF-FLAVOR. HOWEVER, OFF-FLAVOR CAN ALSO APPEAR WHEN CATFISH ARE TRANSPORTED. PREVENT AND TREAT ANY OFF-FLAVOR PROBLEMS AS MUCH AS POSSIBLE.

3. Harvest during the cooler morning hours (when possible)

   NOTE: Higher water temperatures hold lower amounts of dissolved oxygen and increase the stress level of catfish.

4. Stop feeding your fish at least 3 days before you harvest in summer (at least one week in winter)

   NOTE: Processors will charge you for any feed left in your fish. This feed increases the weight of the fish but reduces the yield from processing.

5. Know what harvesting and holding equipment you will need before you need it

   NOTE: If you are using "custom" harvesting from a processor, find out in advarce the equipment and/or labor that you are responsible for providing.

B. Harvesting Cages

Basic Equipment

1. Dip net -- to remove market-size fish from each cage
2. Basket/bucket -- to hold harvested fish for weighing
3. Scale -- to weigh harvested fish; mounted on a tripod for harvesting small amounts or small cages, mounted on a hoist for harvesting large amounts or large cages
4. Holding nets, cages, or hauling truck -- to hold harvested and weighed fish
5. Dock and hoist (optional) -- to lift large cages or weigh large amounts of fish at one time
6. Other equipment -- waders, gloves, boat (if needed)

Basic Steps

1. Bring each cage to the harvest area

   CAUTION: MOVE CAGES CAREFULLY. CAGES CAN RIP OPEN IF SNAGGED, AND CAGE BOTTOMS CAN COME OFF IF YOU LIFT THE CAGE COMPLETELY OUT OF THE WATER.

2. Raise the cover and remove fish with a dip net (See Figure 8-1)
3. Remove any undersize fish and put the market-size fish in a basket or bucket for weighing (See Figure 8-2)
4. Weigh the fish and record the total weight and number of fish in the basket or bucket (See Figure 8-3)
5. Transfer the weighed fish to a holding net or cage (See Figure 8-4)
6. Lift the cage, if needed, to reach any remaining fish (See Figure 8-5)

   CAUTION: LIFT CAGES CAREFULLY. CAGE BOTTOMS CAN COME OFF IF YOU LIFT THE CAGE COMPLETELY OUT OF THE WATER.

7. Continue until you have harvested the amount needed, or until the cage contains no market-size fish

8. Transfer the harvested fish to a holding tank

NOTE: See "Holding and Transporting Your Fish."

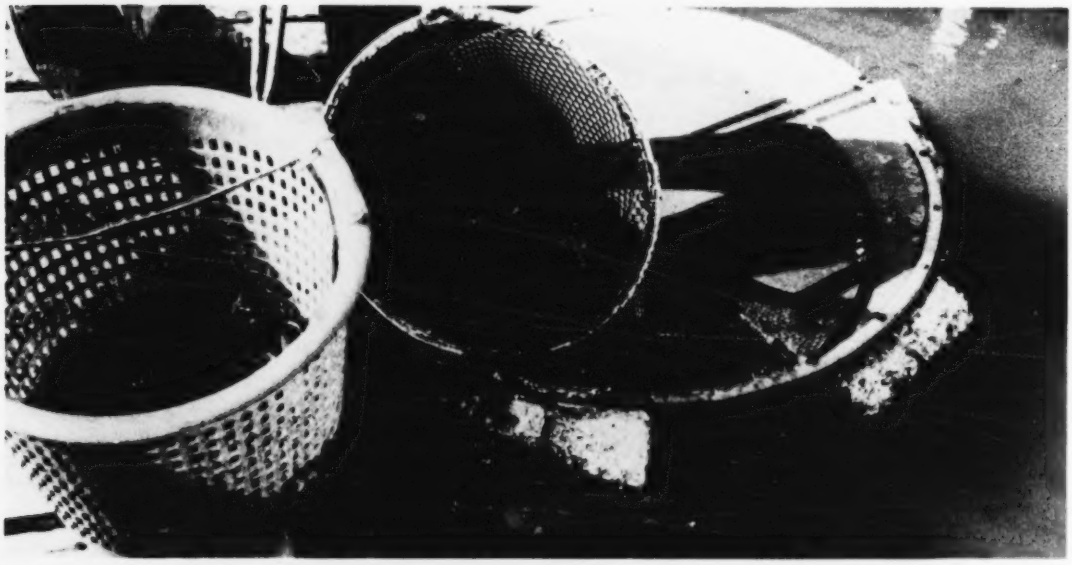


Figure 8-1. Removing fish with a dip net.

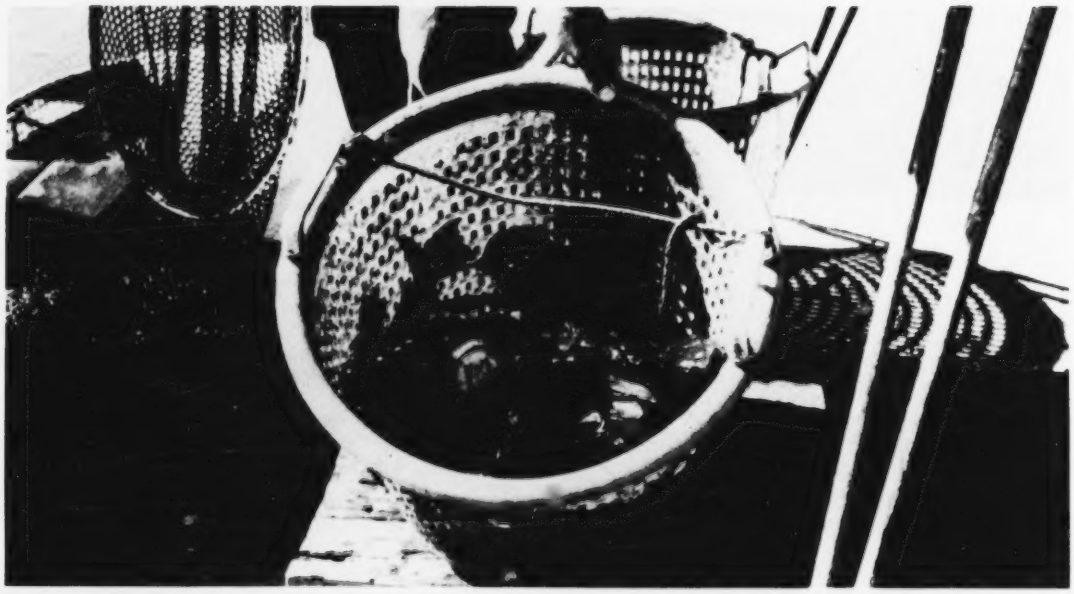


Figure 8-2. Market-size fish in a basket for weighing.

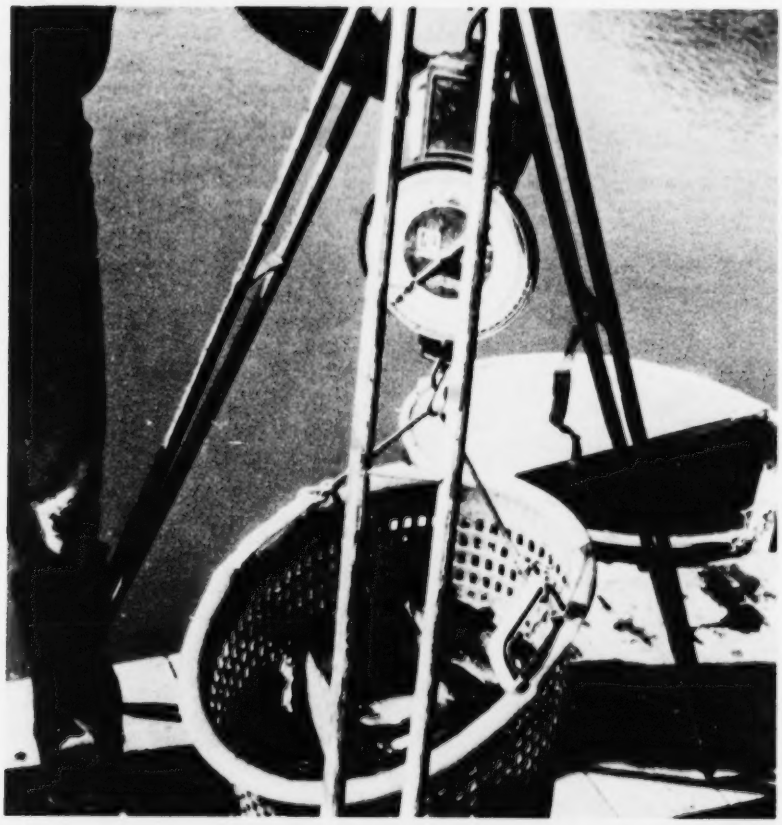


Figure 8-3. Weighing your fish (in small amounts).

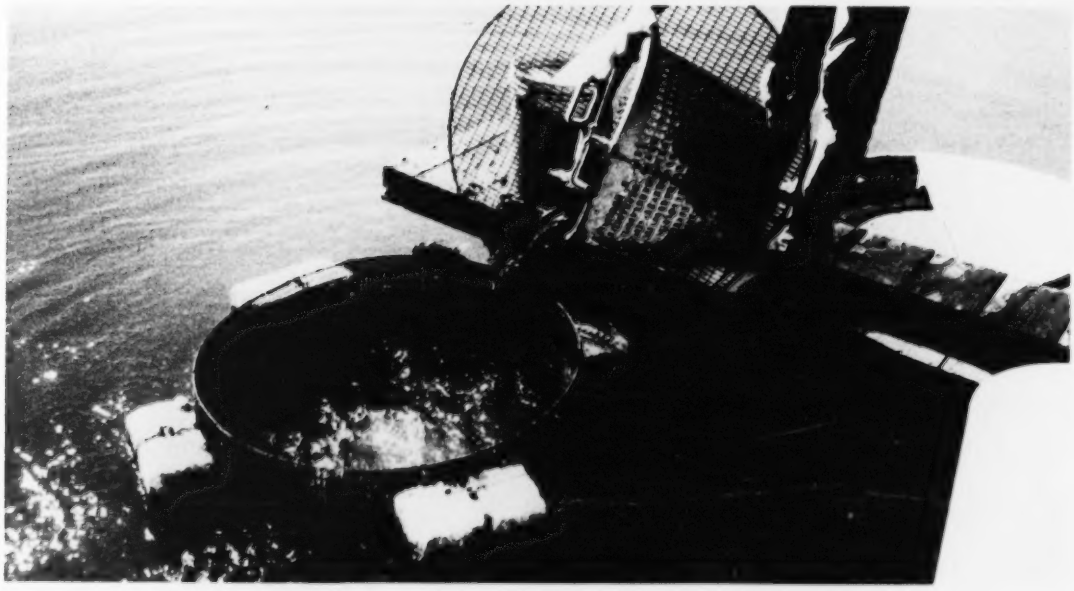


Figure 8-4. Transfering weighed fish to a holding cage.

Figure 8-5. Lifting a cage to reach remaining fish.

C. Harvesting Ponds

Basic Equipment

Seining (whole ponds)

1. Seine

   * Of the right size mesh for the size of fish harvested
   * Bottom-weighted (to keep the seine along the pond bottom during the harvest)
   * With a lead line/mud line (for muddy pond bottoms)
   * Large enough to cover the width and depth of the pond

   NOTE: A good size seine is usually 1 1/2 times the width of the pond and 1 1/2 times the depth of the pond at the pond's deepest part.

Square mesh size (inches)	Fish size held (at least)
1 3/4 - 2	2 pounds
1 5/8	1 to 1 1/2 pounds
1 3/8	3/4 pounds
1	8-10 inches
3/4	7-8 inches
1/2	4-5 inches
3/8	3-4 inches
1/4	1-2 inches

2. Seine reel (optional for small operations) -- to store the seine (See Figure 8-7)

3. Truck and/or tractor

   * To pull a seine reel while unrolling the seine

   * To hold a boom, scale and basket for weighing and moving harvested fish

4. Dip net -- to remove market-size fish from the seine

5. Basket (boom-mounted if possible) -- to hold harvested fish for weighing

6. Scale (boom-mounted if possible) -- to weigh harvested fish (See Figure 8-8)

7. Net stakes -- to support the seine during the harvest

8. Other equipment -- waders, gloves, boat (if needed)

Considerations for Custom Harvesting

---

* Determine the cost-effectiveness of custom harvesting compared to harvesting your own catfish
* Plan with processors several weeks in advance
* Know the minimum loads, average price per pound, the processor's purchasing procedures, and hauling and pickup costs
* Meet the requirements of the harvesters for access to your ponds (See "Planning for Pond Culture" in Unit 4)
* Understand the different responsibilities of the processor and the farmer
* Correct any off-flavor problems in advance of the harvest

Trap-seining (difficult ponds)

NOTE: Consider trap-seining (a) if your whole ponds cannot be easily seined, i.e., if your ponds have irregular bottoms, are too deep, have shore obstructions such as trees, etc; (b) if you must harvest several ponds regularly; or (c) if you are harvesting small amounts.

1. Trap-seine

2. Dip net

3. Basket/bucket

4. Scale

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5. Other equipment -- waders, gloves, boat (if needed)

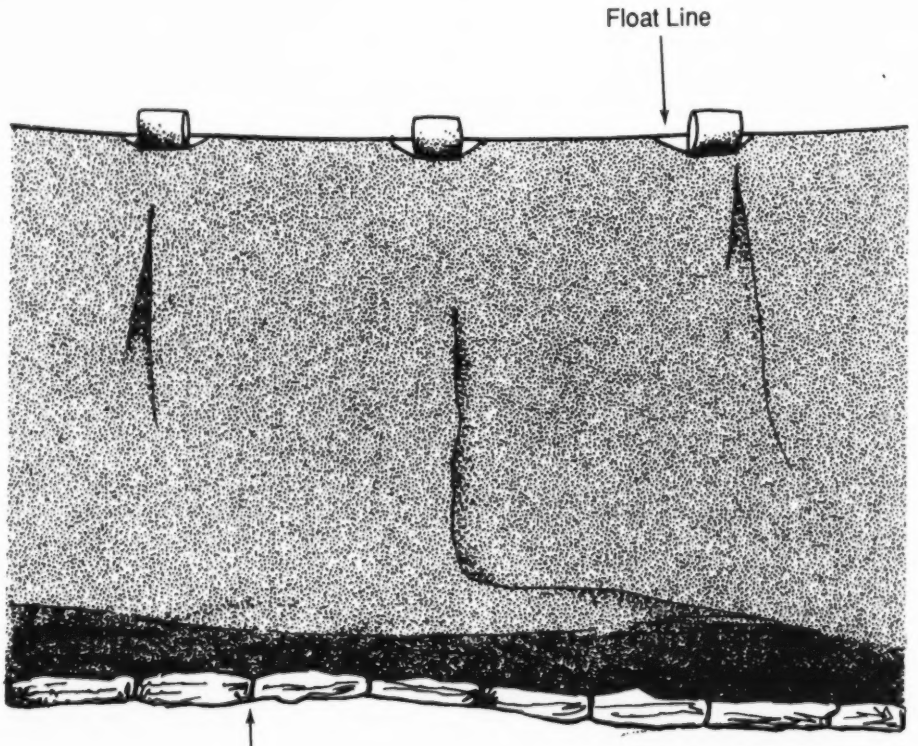

Figure 8-6. A commercial fish seine.

Basic Steps **Seining**

1. Spread the seine around one end of the pond, by hand or by pulling a seine reel with a truck or tractor (depending on the size of the pond and your operation)

2. Pull the ends of the seine toward the harvest area, until the fish are collected in one area (See Figure 8-9)

   NOTE: Keep the lead line ahead of the float line.

3. Support the seine with net stakes (See Figure 8-10)

   NOTE: You might want to bring the lead line onto the shore before setting the net stakes, depending on the depth of the water. This will help prevent catfish from escaping.

4. Lower the basket into the seine

5. Harvest the market-size fish with a dip net, putting the fish in the basket (See Figure 8-11)

6. Raise the basket out of the water, weigh and record the total weight and number of fish in the basket, and transfer the weighed fish to a holding tank or transport truck (See Figures 8-12 and 8-13)

   NOTE: See "Holding and Transporting Your Fish."

7. Continue until you have harvested the amount needed

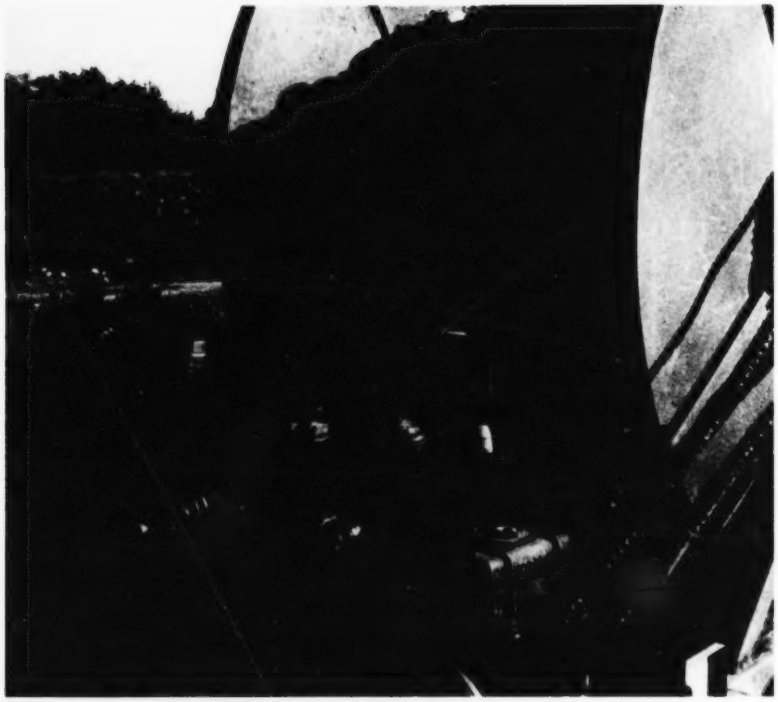

Figure 8-7. A motorized seine reel.

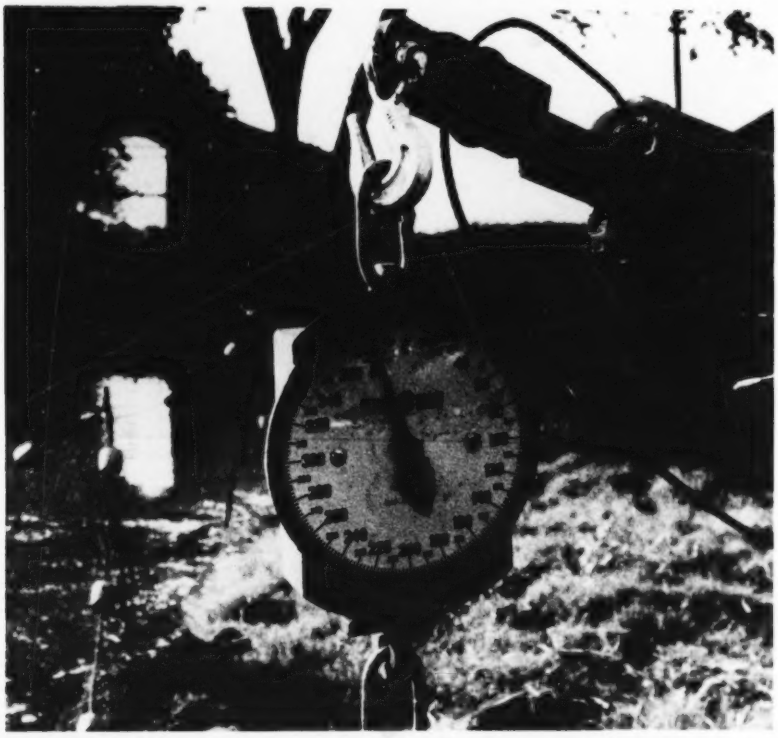

Figure 8-8. A scale mounted on a boom.

Figure 8-9. Pulling the ends of the seine toward the harvest area.

Figure 8-10. Supporting the seine with net stakes.

Figure 8-11. Harvesting the fish with a dip net.

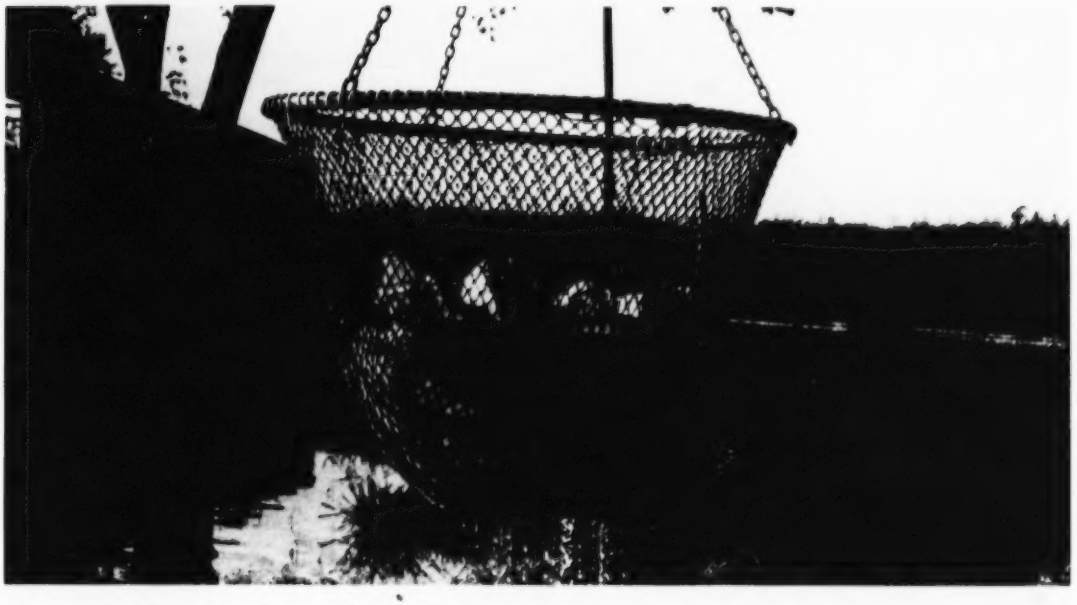

Figure 8-12. Raising the harvested fish out of the water.

Figure 8-13. Transfering the harvested fish to a transport tank.

Trap-seining

1. Prepare the seine the day before the harvest

   NOTE: The seine should be ready and unrolled on the shore.

2. Feed your fish close to shore and offer just enough feed to attract the catfish to the harvest area

3. Keep noise and activity down (at all times)

4. Stretch a rope across the pond 1-2 days before harvesting

   NOTE: The rope should be attached to the seine left on the bank.

5. Carefully bring the seine into the water behind the feeding fish

6. Drav the seine quickly toward the harvest area and the feeding fish (See Figure 8-14)

7. Close the ends of the seine closely together, enclosing the trapped fish (See Figure 8-15)

8. Harvest the market-size fish with a dip net, putting the fish in the basket

9. Weigh and record the total weight and number of fish in the basket, and transfer the weighed fish to a holding tank

10. Continue until you have harvested the amount needed

Figure 8-14. Drawing the seine toward the harvest area.

Figure 8-15. Closing the ends of the seine together.

D. Holding and Transporting Your Fish

Options in Holding and Transporting

NOTE: Your options in holding and transporting your harvested catfish will depend on your markets and any agreements that you have with each market.

1. Buyers transport your fish from your facility

   EXAMPLE: Processors, custom harvesters, live haulers, other fish farmers, etc.

2. You transport your fish from your facility to your buyers

   EXAMPLE: Restaurants, clubs and organizations, farmer's markets, civic groups, etc.

3. You hold your fish for direct sales from your facility

   EXAMPLE: Pond bank sales, fee fishing, etc.

Requirements for Holding

1. Holding tanks -- to hold fish between harvesting and transporting (if needed)

   * Area for overflow to regulate depth and for constant flushing of the tank

   * Shaped for easy dipping of fish for transfer to a transport tank

   NOTE: Test all holding tanks before you harvest.

2. Transport tank(s)

   * Commercially available or home-built
   * Made from aluminum, fiber glass, plywood, or a combination of materials
   * Insulated or uninsulated
   * Divided into compartments to hold specific numbers of fish
   * Firmly attached to trucks
   * Have a release gate and chute(s) for easier unloading

   NOTE: Test all transport tanks before you harvest.

3. High-quality water

   * From the original water source (not city water or chlorinated water)
   * Clean
   * Well-aerated with agitators, aerators, water exchange, or other method
   * Cooler to lower stress and metabolism
   * Flushed daily (constantly for holding)

4. Aeration equipment (and backup)

   * For holding tanks
   * For transport tanks
   * For emergency backup in case of equipment failure

5. Reduced stress level

   * No overcrowding
   * Cooler water
   * Handling only when necessary
   * Salt in transport tanks (to guard against bacterial infection)

Requirements for Transporting

In addition to the "Requirements for Holding and Transporting," transporting live catfish also requires:

1. Transport tank(s) firmly attached to trucks

2. Truck (3/4-ton or larger, heavy duty)

3. Aeration equipment for holding tanks and for emergency backup

   NOTE: The dissolved oxygen in transport tanks should not depend on the reliability of a single power source.

4. Dechlorinator

   NOTE: During transport, you might have to replace water that is lost. Use dechlorinator if you must add chlorinated water.

5. Anti-foaming surfactant (a surface-acting agent)

   NOTE: Water in transport tanks can create large amounts of foam. An anti-foaming surfactant can reduce the amount of foam produced.

6. Emergency generator or bottled compressed oxygen with diffusers (in case of truck or other power failure)

NOTE: Talk to experienced catfish farmers and state experts about requirements for transporting catfish.

Guidelines for Transporting

1. Use clean, well-aerated water

   NOTE: Have emergency aeration equipment ready, in case of equipment failure, power failure, or a sudden change in the dissolved oxygen level.

2. Lower the water temperature to reduce stress

   NOTE: Twenty pounds of ice can lower the temperature of 100 gallons of water by about 2 degrees (Fahrenheit), more or less. Insulated tanks need less ice.

3. Avoid temperature extremes greater than 5-10 degrees Fahrenheit between the pond water and the water in the transport tank (especially when restocking)

   NOTE: Add pond water to the transport tank, until the tank water temperature is near the pond water temperature.

4. Stop feeding your fish before harvesting, holding, and transporting (at least 3 days before harvesting)

Transport Problems with Feed

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* Digestion of feed requires more oxygen than usual, which can cause a problem with the dissolved oxygen level in transport tanks
* Stomach contents of fish can foul the tank during transport
* Processors will charge farmers for feed in harvested fish -- feed in harvested catfish increase the weight of the fish, but reduce the yield from processing

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5. Add enough stock salt to the transport tank to make a 1.0% salt solution by weight of water

   NOTE: This salt solution can kill some parasites, reduce stress during transport, and guard against bacterial infections.

WORKSHEET 8-1 -- Recording Harvest Information

Instructions

1. Complete this "Harvest Record" (or your own version) each time you harvest

2. Do not use your recorded total harvest weight to calculate your sale

   CAUTION: CATFISH CAN LOSE 3-10% OF THEIR WEIGHT AFTER HARVESTING AND TRANSPORTING, DUE TO STRESS.

3. Keep this Record as a part of your permanent recordkeeping system

WORKSHEET 8-1 -- Recording Harvest Information

HARVEST RECORD

BUYER_____ DATE_____

Pond or Cage Number	Weight/Number of fish per scale reading				TOTAL Weight/Number per pond or cage
Example	35/38	40/46	29/32	31/37	135 lbs/153 fish
TOTAL HARVEST (Weight/Number)					

Notes

_____

_____

_____

_____

8. Harvesting Your Fish

Unit Review

1. Describe two (2) types of harvests.

   a. _____

   _____

   _____

   b. _____

   _____

   _____

2. Explain when to harvest.

   a. _____

   _____

   b. _____

   _____

   c. _____

   _____

3. Describe methods of harvesting.

   a. For cage cultures -- _____

   _____

   b. For pond cultures -- _____

   _____

4. Identify basic guidelines for planning your harvest by writing an X in the space beside each guideline.

   _____a. Coordinate your harvests with your suppliers

   _____b. Coordinate your harvests with your markets

   _____c. Lower the water temperature to reduce stress

   _____d. Raise the water temperature to reduce stress

_____e. Sample your fish for off-flavor and correct the problem before you harvest

_____f. Harvest during the cooler morning hours (when possible)

_____g. Stop feeding your fish at least 3 days before you harvest in summer (at least one week in winter)

_____h. Know what harvesting and holding equipment you will need before you need it

5. List basic equipment for harvesting cages.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

6. List in order the basic steps for harvesting cages by writing a "1" beside the first step, a "2" beside the second step, etc.

_____a. Bring each cage to the harvest area

_____b. Weigh the fish and record the total weight and number of fish in the basket or bucket

_____c. Raise the cover and remove fish with a dip net

_____d. Transfer the harvested fish to a holding tank

_____e. Transfer the weighed fish to a holding net or cage

_____f. Remove any undersize fish and put the market-size fish in a basket or bucket for weighing

_____g. Lift the cage, if needed, to reach any remaining fish

_____h. Continue until you have harvested the amount needed, or until the cage contains no market-size fish

7. List basic equipment for harvesting ponds (equipment for seining and trap-seining, without repeating any equipment).

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

h. _____

8. List in order the basic steps for seining by writing a "1" beside the first step, a "2" beside the second step, etc.

_____a. Spread the seine around one end of the pond, by hand or by pulling a seine reel with a truck or tractor (depending on the size of the pond and your operation)

_____b. Lower the basket into the seine

_____c. Support the seine with net stakes

_____d. Harvest the market-size fish with a dip net, putting the fish in the basket

_____e. Continue until you have harvested the amount needed

_____f. Pull the ends of the seine toward the harvest area, until the fish are collected in one area

_____g. Raise the basket out of the water, weigh and record the total weight and number of fish in the basket, and transfer the weighed fish to a holding tank or transport truck

9. List in order the basic steps for trap-seining by writing a "1" beside the first step, a "2" beside the second step, etc.

_____a. Feed your fish close to shore and offer just enough feed to attract the catfish to the harvest area

_____b. Carefully bring the seine into the water behind the feeding fish

_____c. Close the ends of the seine closely together, enclosing the trapped fish

_____d. Draw the seine quickly toward the harvest area and the feeding fish

_____e. Harvest the market-size fish with a dip net, putting the fish in the basket

_____f. Continue until you have harvested the amount needed

_____g. Weigh and record the total weight and number of fish in the basket, and transfer the weighed fish to a holding tank

_____h. Keep noise and activity down (at all times)

_____i. Prepare the seine the day before the harvest

_____j. Stretch a rope across the pond 1-2 days before harvesting

10. State options in holding and transporting.

a. _____

b. _____

c. _____

11. Identify five (5) requirements for holding by writing an X in the space beside each of the requirements in the list below.

_____a. Holding tanks

_____b. Transport tank(s)

_____c. Truck (3/4-ton or larger, heavy duty)

_____d. High-quality water

_____e. Emergency generator or bottled compressed oxygen with diffusers (in case of truck or other power failure)

_____f. Aeration equipment (and backup)

_____g. Reduced stress level

12. Identify four (4) requirements for transporting by writing an X in the space beside each of the requirements in the list below.

_____a. Holding tanks

_____b. Transport tank(s) firmly attached to trucks

_____c. Area for overflow to regulate depth and for constant flushing of the tank

_____d. Truck (3/4-ton or larger, heavy duty)

_____e. Dechlorinator

_____f. Aeration equipment for holding tanks and for emergency backup

_____g. Emergency generator or bottled compressed oxygen with diffusers (in case of truck or other power failure)

_____h. Anti-foaming surfactant (a surface-acting agent)

13. Identify basic guidelines for transporting by writing an X in the space beside each guideline.

_____a. Use clean, well-aerated water

_____b. Raise the water temperature to reduce stress

_____c. Lower the water temperature to reduce stress

_____d. Avoid temperature extremes greater than 5-10 degrees Fahrenheit between the pond water and the water in the transport tank (especially when restocking)

_____e. Feed your fish before transporting

_____f. Stop feeding your fish before harvesting, holding, and transporting (at least 3 days before harvesting)

_____g. Add enough stock salt to the transport tank to make a 1.0% salt solution by weight of water

To check your answers, review the unit.